A prospective study on

FUNCTIONAL OUTCOME OF DISPLACED MID-SHAFT CLAVICLE FRACTURES TREATED WITH TITANIUM ELASTIC NAIL SYSTEM

Dissertation submitted to
THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY
Chennai

In partial fulfillment of the regulations
for the award of the degree of

MS (ORTHOPAEDIC SURGERY)
BRANCH – II

MADRAS MEDICAL COLLEGE, CHENNAI

MARCH - 2013

CERTIFICATE

This is to certify that this dissertation in **"Functional outcome of Mid-shaft Clavicle fracture treated with Titanium Elastic Nail System - Short term prospective outcome analysis"** is a bonafide work done b Dr.R.VIVEKANANDAN under my guidance during the period2010–2013. This has been submitted in partial fulfillment of the award of M.S. Degree in Orthopedic Surgery (Branch–II) by the Tamilnadu Dr.M.G.R. Medical University, Chennai.

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DECLARATION

I, **Dr.R.VIVEKANANDAN,** solemnly declare that the dissertation titled **"FUNCTIONAL OUTCOME OF DISPLACED MID-SHAFT CLAVICLE FRACTURES-SHORT TERM PROSPECTIVE OUTCOME ANALYSIS"** was done by me at the Rajiv Gandhi Government General Hospital, Chennai-3, during 2010-2013 under the guidance of my unit chief **Prof.A.PANDIASELVAN**, **M.S(Ortho), D.Ortho.**

The dissertation is submitted in partial fulfillment of requirement for the award of M.S. Degree (Branch –II) in Orthopaedic Surgery to **The Tamil Nadu Dr.M.G.R.Medical University.**

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ACKNOWLEDGEMENT

I express my deepest gratitude to **Prof.Dr.V.KANAGASABAI**, **M.D.**, Dean, Madras Medical College & Rajiv Gandhi Govt. Gen. Hospital for providing mean opportunity to conduct this study.

I would like to express my gratitude and reverence to the Director, Institute of Orthopaedics & Traumatology, Madras Medical College & Rajiv Gandhi Govt Gen Hospital, **Prof Dr. M.R.Rajasekar** M.S.(orth) D.Orth for his invaluable help and guidance.

I express my sincere gratitude to my unit chief and guide **Prof. Dr. A. Pandiaselvan** M.S.(orth) D.Orth**,** Professor, Institute of Orthopaedics & Traumatology, Madras Medical College & Rajiv Gandhi Govt. General Hospital whose blessings, support and guidance helped me complete the study.

I express my sincere thanks and gratitude to **Prof.Dr.N.Dheen Mohammed Ismail** M.S.(orth) D.Orth Professor, Institute of Orthopaedics & Traumatology, Madras Medical College & Rajiv Gandhi Govt. General Hospital for his constant and guidance provided during the study.

I express my sincere thanks and gratitude to **Prof.Dr.V.Singaravadivelu** M.S.(Orth) D.Orth Professor, Institute of

Orthopaedics & Traumatology, Madras Medical College & Rajiv Gandhi Govt. Gen Hospital for his constant guidance provided during the study.

I am very much grateful to **Prof. R. SUBBIAH,** M.S.Orth., D.Orth, for his unrestricted help and advice throughout the study period.

I sincerely thank **Prof. NALLI R. UVARAJ** M.S.Orth., D.Orth**.,** for his advice, guidance and unrelenting support during the study.

My sincere thanks to **Prof. Dr. R.H. GOVARDHAN** M.S,Orth., D.Orth., former director, **Prof. S.SUBBAIAH.,** M.S,Orth., D.Orth**.**, and **Prof.V.THULASIRAMAN,** M.S,Orth., D.Orth., Retired professors, Institute Of Orthopaedics and Traumatology, for their valuable advice and guidance

I sincerely thank **Dr. R. SELVARAJ**M.S.Orth., D.Orth., for his advice, guidance and unrelenting support during the study.

I am extremely indebted to my co-guide **Dr.S.SENTHIL SAILESH M.S(Orth)** for his constant encouragement, clarifications and guidance provided during the study.

I sincerely thank, Dr.A. Shanmugasundram, Dr.Manimaran K.P, Dr.S.Karunakaran, Dr.R.Prabhakaran, Dr.Nalli R.Gopinath, Dr.G.Hemanth Kumar, Dr.P.Kingsly, Dr.J.Pazhani,

Dr.MuthukumarDr.N. Muthazhagan, Dr.M.Mohammed Sameer, Dr.Kannan, Assistant Professors of this department for their valuable suggestions and help during this study.

I thank all anesthesiologists and staff members of the theatre for their endurance during this study.

I am grateful to all my post graduate colleagues for helping in this study. Last but not least, my sincere thanks to all our patients, without whom this study would not have been possible.

CONTENTS

INTRODUCTION

Clavicle fractures are common in children and young adults, commonly occurring in persons younger than 25 years. Clavicle becomes the most common site of injury because of its subcutaneous superficial location, thin midshaft, and the forces transmitted across it. The mechanism of injury is usually forceful fall with outstretched hand, which occurs commonly during contact sports.

Clavicle fractures comprise about 30 -40% of all shoulder girdle injuries(1). Midshaft clavicular fractures accounts for 80-85% of them(2)Traditional view that all clavicle fractures heal with good functional outcome no longer holds good.(3).

Midclavicular fractures are generally managed conservatively, e.g. with a figure-of-eight-bandage. Imminent perforation of the skin, impending or existing neurovascular compromise and the floating shoulder and gross displacement of fracture fragments were absolute indications for operative treatment.

A number of publications described the technique of minimally-invasive osteosynthesis using elastic stable intramedullary nails (ESIN). Early functional recovery and a rapid return to daily activities and low complication rate have been reported as advantages.

AIMS AND OBJECTIVES

The aim of the study is

- To analyse the functional outcome of mid-shaft clavicle fractures treated with flexible intramedullary nails in our Institution.
- To study the complications of the surgery
- To study the duration of bony union following fixation with intra medullary nailing

REVIEW OF LITERATURE

MIDDLE THIRD CLAVICLE FRACTURES

On hearing the phrase ‘clavicle fracture’ it will likely bring to us images of simple injuries, simple treatments and favourable outcome. But of late a great deal of controversy exists in the management of clavicle fractures.

Hippocrates said that a patient with a fracture clavicle could be treated conservatively by observation the treating physician “ would not be sorry at the neglect of the patients”, although deformity was universal, functional outcome and bony union are expected equally.

Fractures of middle 3rd of clavicle are underestimated with respect to pain and disability during the first three weeks of treatment. It is impossible to support and immobilize a fracture of middle 3rd of clavicle in an adult by external means with figure-of-eight bandages (5)

Neer observed that only 3of 2235(0.1%) patients with middle third clavicle fracture treated conservatively healed whereas 2 of 45 patients (4.6%) treated with immediate open reduction and internal fixation . So, he felt, the primary cause of non -union to be open reduction and internal fixation. (6)

Clinical trials have shown that surgical treatment results in a lower rate of fracture nonunion and improved functional outcomes compared with nonoperative treatment Though non- operative treatment is a viable option to treat displaced mid –shaft fractures, operative repair should be considered in patients with significant fracture displacement and clavicle shortening, the risk factors for nonunion(7).

In a retrospective clinical study of 52 non operatively treated displaced fractures with initial shortening of >20 mm showed increased risk of non-union and poor functional outcome(8). A later study also showed shoulder strength deficit and endurance with non operative management using patient based outcome measures(9).

In a multicenter trial which compared non operative treatment with plate fixation for displaced fractures in138 peoples showed better functional results, lower malunion and non-union rates, time to union was shorter in the operated group(10). But this group had a complication rate of 34% and a re -operation rate of 18%, most reoperations were for hardware removal .The use of plate fixation was found to be associated with complications such as infection(11), plate failure,(11) hypertrophic or dysesthetic Scars(13), implant loosening(11,14), non-union(12), refracture after implant removal (11,12,14), and intraoperative vascular injury (15).

Complications such as infection, non-union, failure of implant, and poor cosmetic appearance of the incision are associated with plate fixation (Bostman et al. 1997)(17), intra medullary nails can be safely used (Chu et al. 2002)(19), Jubelet al. 2003) (18).

Minimally invasive ESIN was established as an alternative to plate fixation. JUBEL*etal*. (16) showed that the correction of clavicular shortening is a prerequisite for good functional outcome.

F. Hartmann et al retrospectively reviewed consecutive series of 15 patients between 2003 and 2006 with mid clavicular fractures that were treated with elastic intramedullary nailing using the Titanium Elastic Nailing (TEN) System and followed them up over a period of 1 year. Patients with A-typefractures (simple fractures, two fragments) and B-type fractures (fractures with bending wedge) according to the classification of the Orthopaedic Trauma Association (OTA) were included in this study. Assessment of the patient's outcome included subjective evaluation of pain complaints according to the visual analogue scale (VAS), evaluation of the clinical shoulder function according to the Constant-Murley Score and radiologic evaluation of fracture healing. Time to functional recovery and complications were also assessed. In all patients clinical and radiological union observed (*ActaChirBelg*, 2008, 108, 428-432) (15).

Mark Kettler et al, did a prospective study on 87 patients with midshaft clavicle fractures treated with titanium elastic nail system they include fractures with >2cm shortening and displacement > shaft width. They assessed the outcome using DASH score ,and constant score. They observed better results with Titanium Elastic nail compared to plate fixation. Less soft tissue dissection and better compensation of bending and torsional forces by flexible intramedullary nail than a rigid plate might be the reason for better outcome and less complications with titanium elastic nail. Actaorthopedica 2007, 78 (3):424-42.

Christoph MEIER et al *From the Stadtspital Triemli, Zurich, Switzerland* did a prospective case study in 14 athelets with Displaced middle 3rd clavicle fractures to evaluate the indications, technical pitfalls and functional outcome of Titanium elastic nail. Resumption of training with full function was achieved by all patients within 4 week. In selected cases ESIN is a safe and effective method for mid-clavicular fractures with a low complication rate. Restoration of clavicular length is reliable. Cosmetic and functional results are excellent and a quick recovery makes early resumption of training possible postoperatively. (*ActaOrthop. Belg.*, 2006, 72, 269-275)

ANATOMY OF CLAVICLE

The clavicle (collar) bone connects upper limb to the trunk. Medial end which articulates with sternum is wide and thinner at its lateral third. The clavicle assumes a gentle S-shape, This resembles musical symbol the " clavicula" thus the name(20).

Clavicle is present in animals including man who use their upper limb for holding, grasping and climbing. Mammals adapted for running and swimming have lost their clavicle to further mobilize their shoulder girdle(21) .

As humans evolved into a biped and assumed an ortho grade posture, the shoulder girdle underwent changes in order to comply with the demands of a non weight bearing joint.

PECULIARTIES OF CLAVICLE

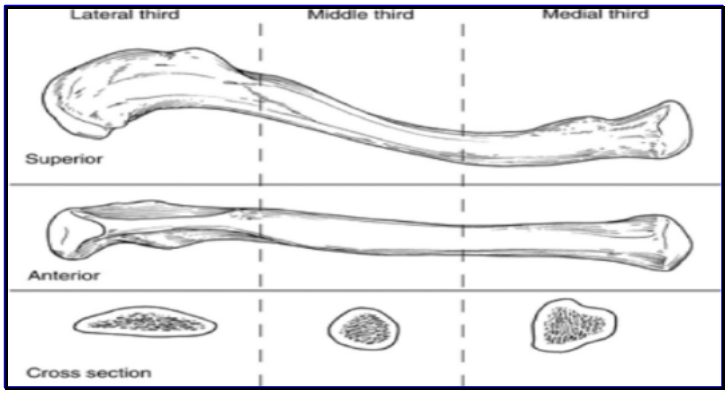
- The shaft ossifies from two primary centre(21).
- The first bone to ossify in the body.
- Only long bone with membranous ossification.
- Only long bone to lie horizontally in the body
- Subcutaneous throughout its whole extent. (21)

OSTEOLOGY

OSSIFICATION:

- It ossifies from two primary and one secondary centre.
- Primary centers (medial and lateral) appear in the shaft between (5-6weeks) of intrauterine period and fuse by about 45th day.
- A secondary centre for sternal end appears at 15th year in females and 17th years in males and unites with shaft at 21st year in females and 22nd year in males.
- A secondary centre sometimes develops in the cartilage at the acromial end at 18-20 years and rapidly unites by 24th years.
- Medial clavicular epiphysis is responsible for the majority(80%) of longitudinal growth(21).

OSSEOUS STRUCTURE



- Greater radius of curvature occur at its medial curve which is convex anteriorly and smaller lateral curve which is convex posteriorly.(22).

SIDE DETERMINATION

- The lateral end is flat, and the medial end is large and quadrilateral.

- The shaft is slightly curved, so that it is convex forwards in its medial 2/3rd, and concave forwards in its lateral 1/3rd.

- The inferior surface is grooved longitudinally in its middle 1/3rd.

GENDER VARIATIONS

- In females clavicle is short, thin , smooth and less curved than in *males* .

- In females lateral end of the clavicle lies below the medial end whereas, in males, the lateral end lies at or slightly higher than the medial end.

- The bone has a cylindrical **shaft**, **lateral and medial ends**.

1. Lateral 1/3rd:

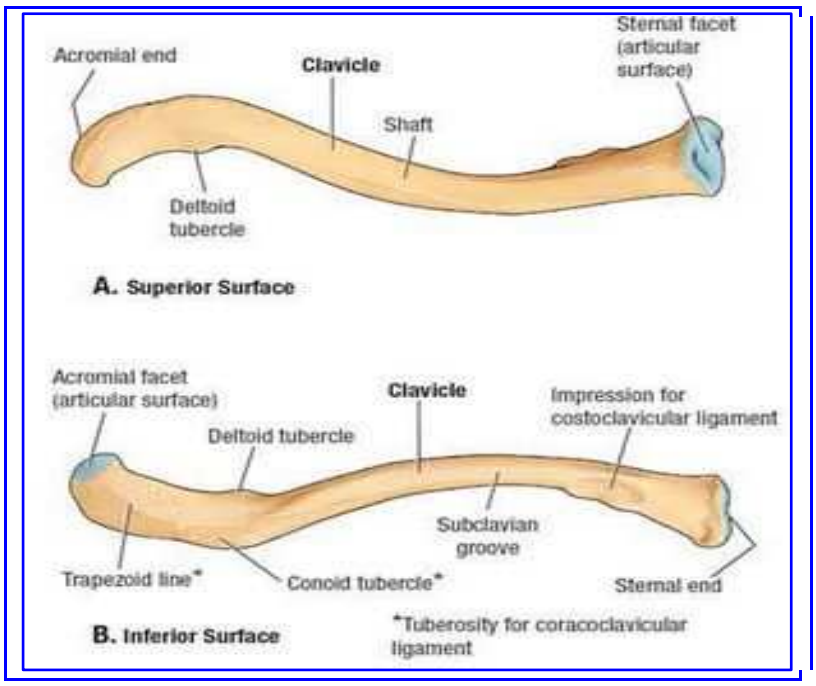
- Flat and thin consists of anterior and posterior borders**,** superior and inferior surfaces.(22)

- **Anterior border:** concave forwards and deltoid muscle originates from it.

- **Posterior border:** convex backwards and trapezius muscle gets attachment to posterior border

- **Superior surface:** it is subcutaneous

- **Inferior surface:** shows conoid tubercle and trapezoidridge which gives attachment to conoid ligament and trapezoid ligament (medial and lateral part of coraco clavicular ligament)respectively.



2. Medial 2/3

It is circular and thick and it consists of **4 surfaces**

- **Anterior surface:** convex forwards and pectoralis major originates from it.
- **Posterior surface:** concave backwards and gives sternohyoid muscle originates from it.
- **Superior surface:** is rough on its medial part
- **Inferior surface:** has rough oval impression at the medial end for costoclavicular ligament and shows subclavian groove which gives attachment to subclavius muscle.

ENDS:

1. Lateral end:

- articulates with the acromian process of the scapula to form the acromion-clavicular joint

2. Medial End:

- articulates with the clavicular notch of the manubrium sterni to form sterno-clavicular joint

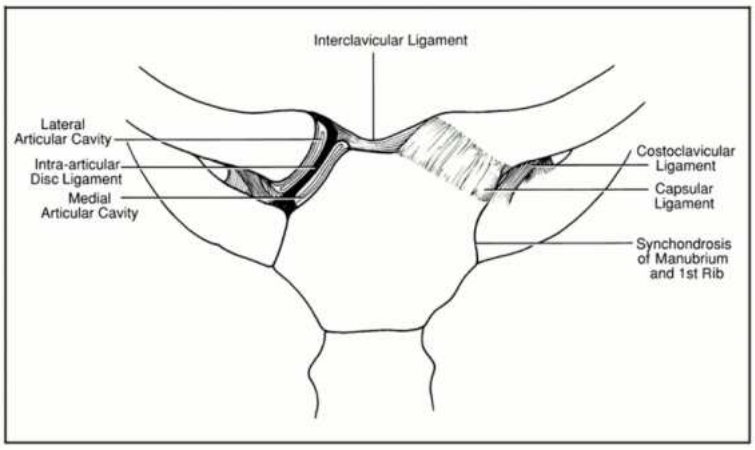
LIGAMENTOUS ANATOMY

Medial ligamentous anatomy

a) Sterno – Clavicular capsule: the clavicle is secured to sternum by sternoclavicular capsule, the thickening of posterior capsule has been the single most important soft tissue constraint to antero-posterior translation of medial clavicle.

b) Interclavicular ligament that runs from medial end of one clavicle and attaches to medial end of contra-lateral clavicle, helps prevent inferior translation.

c) Costoclavicular ligament This Ligament that originate from upper aspect first rib and the adjacent aspect of the sternum attached to rhomboid fossa on the inferior surface are primary resistors to translation(4) .

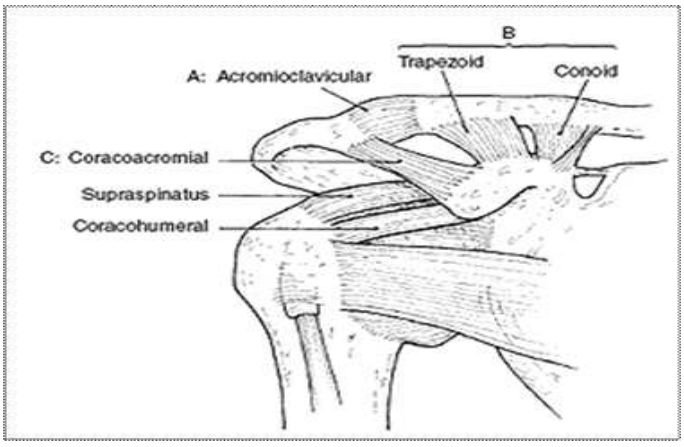


LATERAL LIGAMENTOUS ANATOMY

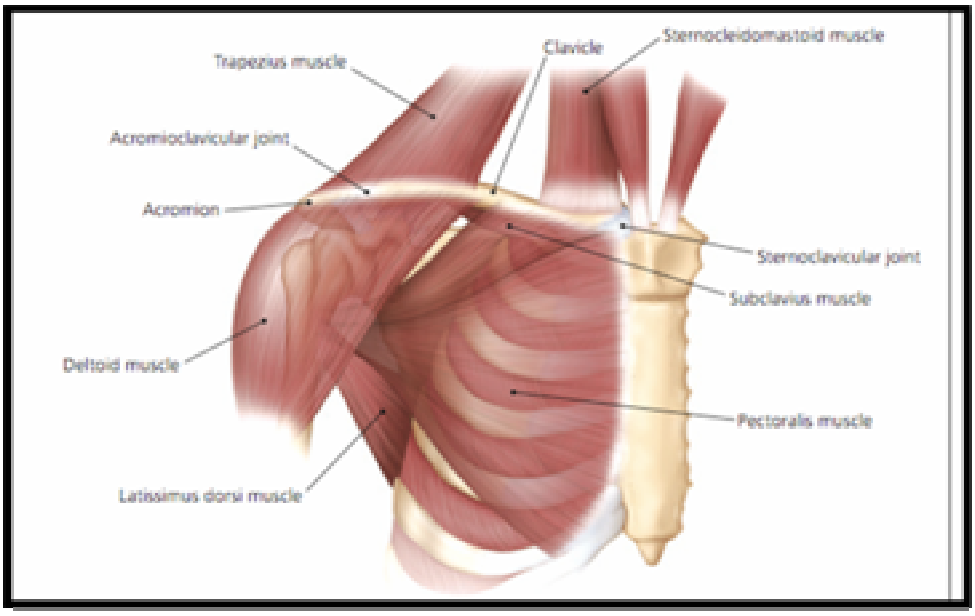
a) The coraco clavicular ligaments

Trapezoid and Conoid, are stout ligaments that arises from base of coracoids and insert onto the osseous ridge of the inferior clavicle(trapezoid) and the clavicularconoid tubercle (conoid). These ligaments are very strong and are the primary resistance to superior displacement of lateral clavicle.

b) The capsule of the acromio-clavicular is thickened superiorly and is primarily responsible for resisting anteroposterior displacement of the joint.



MUSCULAR ANATOMY



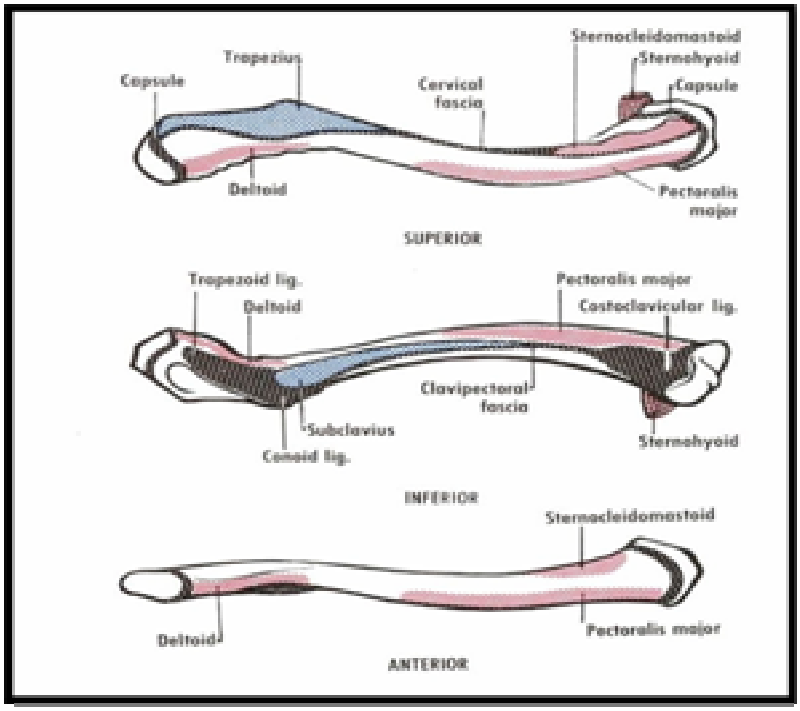
Clavicle acts as a bony frame work for muscle origin and insertion (22)

a) Muscles that insert on the clavicle:

- Upper third of trapezius inserts on to the superior surface of the outer third of the clavicle
- Subclavius muscle arises from first rib anteriorly at the costochondral junction. It proceeds obliquely and inserted into a groove on under surface of the clavicle. This muscle appears to aid in depressing middle third of the clavicle.

b) Muscles arising on the clavicle:

- Clavicular head of deltoid arises from the outer third ofclavicle opposite to the insertion of trapezius.
- Sternocleidomastoid muscle arises from the posterior edge of the medial third of the clavicle



- Pectoralis major arises from the anterior portion of medial two thirds of the clavicle.

- Sternohyoid contrary to its name does have a small origin in the clavicle just medial to the origin of the sternocleidomastoid.

- Platysma originates over the deltoid and pectoralis major. It crosses the superficial anterior surface of the clavicle (23) and runs in the subcutaneous tissue extending superiorly to mandible and deeper fascial muscles

JOINTS

a) Sternoclavicular Joint

- formed between the medial end of the clavicle laterally, the manubrium sterni, and the first costal cartilage medially.

- This is the only true articulation between the upper limb and the trunk.

- It is a synovial two plane joint.
- Capsule is attached to the margins of the articular surfaces and surrounds the entire joint. The capsule is reinforced in front of and behind the joint by the strong sternoclavicular ligaments.
- Anterior sternoclavicular ligament is covered anteriorly by sternomastoid and it blends posteriorly with intra articular disc.
- Posterior sternoclavicular ligament blends with the tendons of sternothyroid and sternohyoid muscle posteriorly.
- Joint surface is covered with hyaline cartilage. A complete disc is found to separate the joint into two compartment.
- Elevation and depression occur in the joint between the disc and the sternum.
- Range of motion is approximately 30 to 35 degrees of upward elevation about 35 degrees in anteroposterior direction and rotation along long axis is about 44 to 50 degrees.
- Most sternoclavicular elevation occurs between 30 and 90degrees of arm elevation.
- Rotation occur at 70 to 80 degrees of arm elevation.
- Fusion of sternoclavicular joint limits abduction to 90 degrees(21,24)

b) Acromioclavicular Joint

- This occurs between the acromion of the scapula and the lateral end of the clavicle.
- Synovial plane joint

- Capsule surrounds the joint and is attached to the margins of the articular surfaces.

- Superior and inferior acromion clavicular ligaments reinforce the capsule; from the capsule, a wedge-shaped fibro cartilaginous disc projects into the joint cavity from above

- The very strong coracoclavicular ligament extends from the coracoid process to the under surface of the clavicle. It is largely responsible for suspending the weight of the scapula and the upper limb from the clavicle.

- Synovial membrane lines the capsule and is attached to the margins of the cartilage covering the articular surfaces.

- The upward and downward movements allows rotation of about 20 degrees between the acromion and clavicle. It occurs during the first 40 degrees and last 20 degrees of elevation

- Motion of the acromioclavicular joint is significantly less than at the sternoclavicular joint but it does play a critical role in allowing full arm motion(.21,24).

Movements

Forward and backward movement of the clavicle takes place in the medial compartment. Elevation and depression of the clavicle take place in the lateral compartment.

Muscles Producing Movement:

The forward movement of the clavicle is produced by the serratus anterior muscle. The backward movement is produced by the trapezius and rhomboid muscles. Elevation of the clavicle is produced by the trapezius, sternocleidomastoid, levator scapulae, and rhomboid muscles. Depression of the clavicle is produced by the pectoralis minor and the subclavius muscles

ANATOMICAL RELATIONS

- Anterior surface of the clavicle is essentially subcutaneous over its course with only the thin platysma and cervical fascia covering it .
- The supraclavicular nerves which provide sensation to the overlying skin are consistently found deep to the platysma muscle layer.
- The strong tubular portion of the clavicle is clothed on its underside by the subclavius muscle and it overlies these vitalstructures which may account for the low incidence of neurovascular injury associated with clavicular fractures. Sometimes it may be entrapped within the fracture site and inhibit healing.
- Immediate relationships of the sternoclavicular joint are the origins of the sternocleidomastoid in front and sternohyoid and sternothyroid muscles behind the joint. (22)
- The Medial anterior curve is often described as an accommodation for subclavian vein, subclavian artery and brachial plexus and the curve is a land mark for finding the subclavian vein (1).

COSTOCLAVICULAR SPACE:

It is the space between medial clavicle and the first rib.

Superficial infraclavicular space:

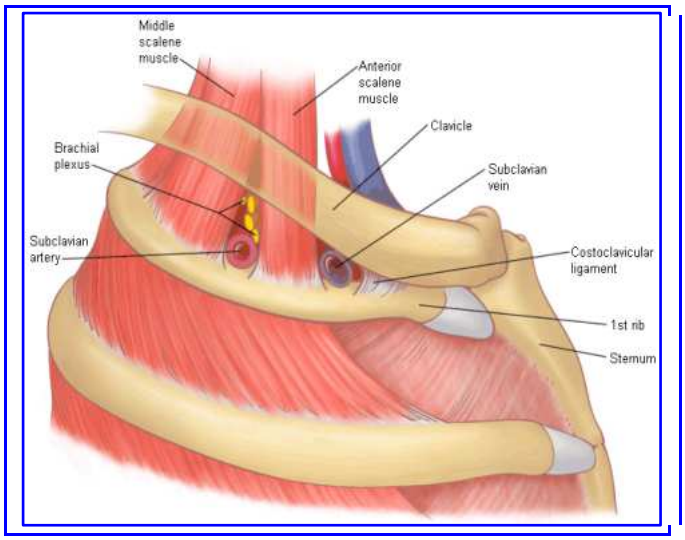
It is formed by pectoralis major and deltoid portion of the clavicle (1).

Grants space:

It is formed by investing layer of cervical fascia anteriorly and omohyoid fascia posteriorly. Here external jugular vein join subclavian vein at its confluence with internal jugular vein (1).

Neurovascular Anatomy:

Anteriorly the supraclavicular nerves and branches of the cervical plexus, that cross the superficial surface of the clavicle deep to the platysma. Jupiter et al recommends identifying and preserving these nerves during surgical procedures to the midclavicle (26).



Clavicle function as an osseous protector of the brachial plexus and jugular and subclavian vessels. The superior surface of the middle third of the clavicle forms the inferior border of the posterior triangle of the neck which contains brachial plexus and subclavian artery.

Blood supply: Main nutrient artery enters just medial to the attachment of corococlavicular ligament.. The suprascapular artery supplied the majority of the clavicle.(27)

BIOMECHANICS

The study of biomechanics refers to the **movement of joint through space** and it attempts to explain both the quality and quantity of joint movement.

There are three axis of clavicular motion.

- Anteroposterior
- Superoinferior
- Rotational

The function of the shoulder girdle requires the integrated motion of the sternoclavicular, acromioclavicular, glenohumeral and scapulothoracic joint.

It is generally accepted that scapulohumeral rhythm occur in a 2:1ratio with the humerus moving 2 degrees for every 1 degree of scapular motion.

During arm elevation the clavicle must elevate to allow the scapulato rotate upwards.

Clavicle rotates totally 70 degrees in an upward fashion during arm elevation.

During elevation of the extremity clavicular elevation of about 30degrees occur with maximum elevation occurring at about 130degrees of arm elevation and depression occur approximately 5degrees in saggital plane. The clavicle also rotates forwards approximately 10 degrees during the first 40 degree of arm elevation.

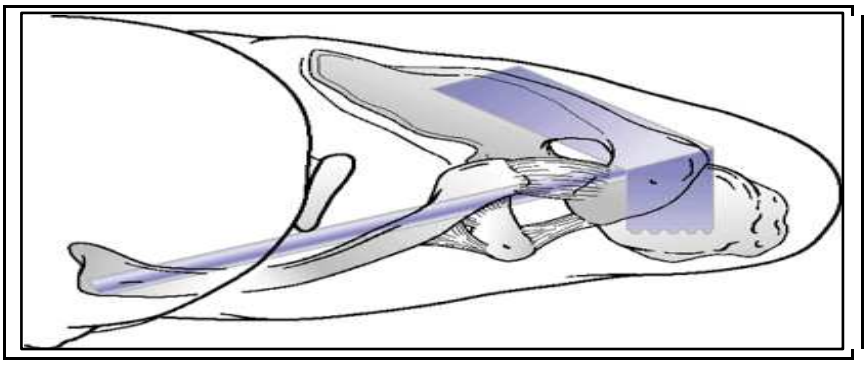
No change takes place during the next 90 degrees of arm elevation but an additional 15 to 20 degrees of forward rotation subsequently occur during the terminal arc.

If the clavicle is not allowed to rotate elevation of arm to only about 110 degrees is possible. Approximately 15 degrees of clavicular protraction and retraction occurs in the frontal plane.

FUNCTIONS OF THE CLAVICLE

Strut Function

The clavicle is responsible for bracing the shoulder girdle and propping it away from the sternum and thoracic cage. Strut allows the shoulder to reach into cross-body and internal rotation positions without medial collapse. The strut function of the clavicle allows the thoracohumeral muscles to maintain their optimal working distance. There by increasing the strength of shoulder girdle movements (30)



2) Power and stability of the arm :

The clavicle serving as a bony link from thorax to shoulder girdle. It contributes significantly to the power and stability of the shoulder especially in movement above shoulder level.

The long clavicle facilitate the shoulder joint to be placed in more lateral position by which upper limb is effectively placed in three dimensional environment(22)

Lateral curvature of clavicle permits it to act as a crank shaft effectively allowing half of the scapular movements. This so called crankshaft mechanism on shoulder abduction provides 30 degrees of the total60 degrees contribution from scapulothoracic motion.(28,29)

3) Muscle attachments:

It provides a bony base for muscle origin and insertion **(**22)

4) Protection of neurovascular structures :

Subclavian vessels, brachial plexus and lungs lies immediately behind the medial third of the clavicle. The tubular cross section of the medial third of the clavicle increases its strength which along with subclaviusmuscle adds to its protective function at this level. (22)

5) Cosmosis:

Cosmetic function is served by the smooth subcutaneous bonyclavicle which provides a graceful shape to the base of the neck(30)**.**

6) Protection to lungs:

It protects the superior aspect of the lungs (22,30).

INCIDENCE OF INJURY

- Clavicle fractures accounts for approximately 2.6% of all fractures in adults (2)10% to 15% in children (31), and comprise about 30 -40% of all shoulder girdle injuries (1).

- Annual incidence in males is highest in under 20 age group.(1)
- The annual incidence in females was more constant with peak seen in teenagers and the elderly(1)
- Clavicle fractures show abimodal age distribution. male patients aged <30 years and elderly patients aged > 70years are at higher risk for clavicle fractures(32)
- 80-85% clavicular fractures occurs in the middle 3rd region.
- 20% fractures occurs in the lateral third region.
- 5% fractures occurs in medial end.(33)

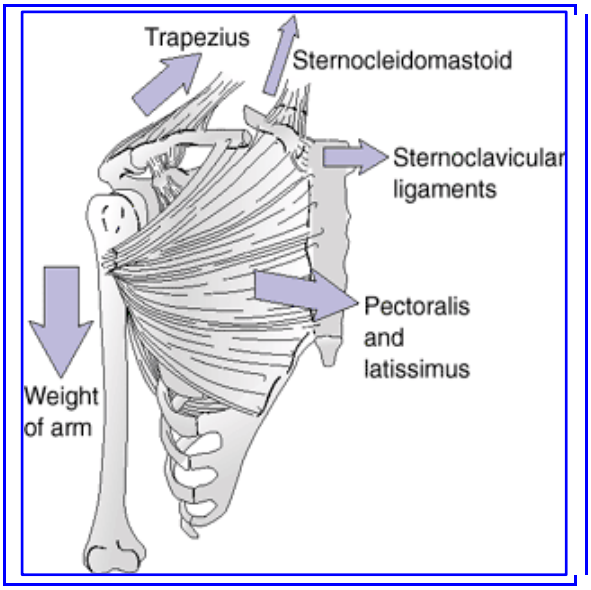
The site of fracture also depends upon the age of the patient and mechanism of injury.

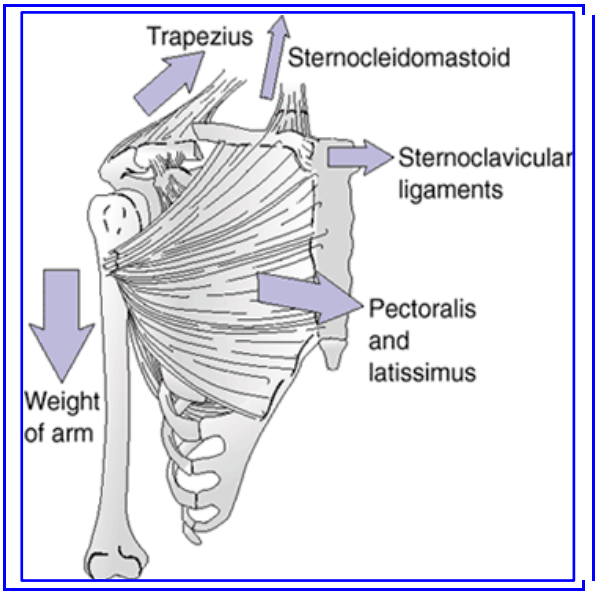
- Elderly - Lateral (distal) and medial third clavicle fracture
- Children - middle third clavicle fracture, undisplaced
- Adolescents - middle third clavicle fracture , displaced/
- Middle aged patient- middle third clavicle fractures.

BIOMECHANICS OF CLAVICLE FRACTURES:

The articulations and muscular attachments that support the normal functions of the clavicle, serve as displacing forces during a fracture. The displacing forces for a midshaft fracture of clavicle, are as follows:

- stabilizing on the medial segment by the sternoclavicular ligaments
- superior on the medial segment through the sternocleidomastoid
- inferior and medial on the lateral segment through the pectoralis major
- inferior on the lateral segment through the weight of the arm pulling through the coracoclavicular ligaments. The trapezius provides a stabilizing force against inferior displacement of the lateral segment.





The whole structure of the shoulder girdle is disrupted when the clavicle fractures. And there is loss of the strut function of the clavicle. The lateral fragment with the glenohumeral joint is generally displaced caudally and ventrally by the muscular force of the pectoralis major combined with gravity and the weight of the arm, whereas the sternocleidomastoid pulls the medial fragment in a cranial and dorsal direction(32)producing its shortening and restricted shoulder function.

CLASSIFICATIONS

ALLMAN CLASSIFICATION OF CLAVICLE FRACTURES

GROUP I – Middle third fractures (80%)

GROUP II – Distal third fractures (15%)

Type I– Minimally displaced / interligamentous

Type II – Displaced fractures, fracture medial to the coracoclavicular ligaments

IIA – Both ligaments (conoid and trapezoid) attached to the distal fragment

IIB – Conoid torn, trapezoid attached to the distal fragment

Type III – Fractures involving articular surface

Type IV – intact coracoclavicular ligaments attached to periosteal sleeve plus proximal fragment displaced

Type V – Comminuted

GROUP III – Fracture of the proximal third (5%)

Type I – Minimally displacement

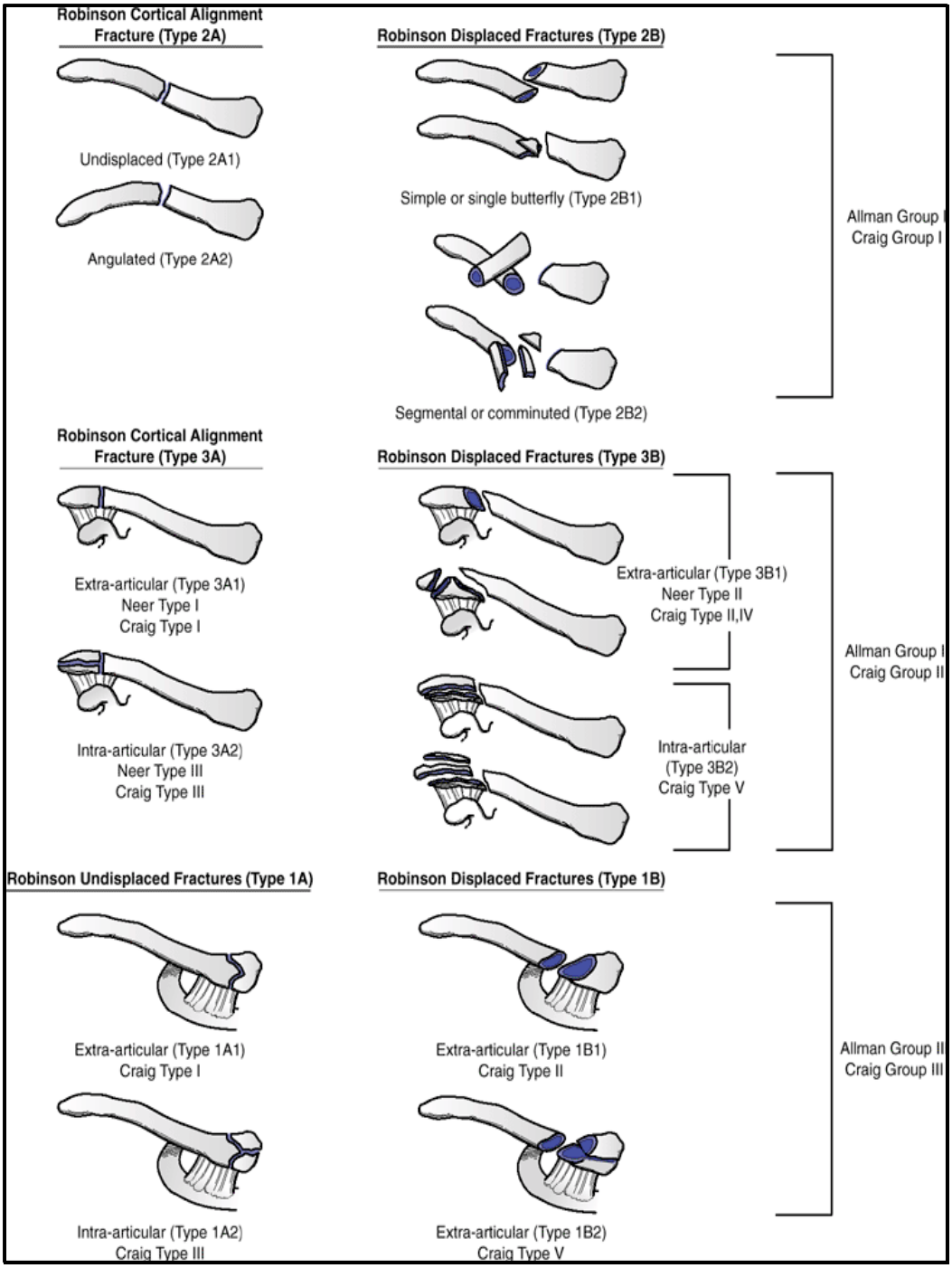
Type II – Displaced

Type III – Intra-articular

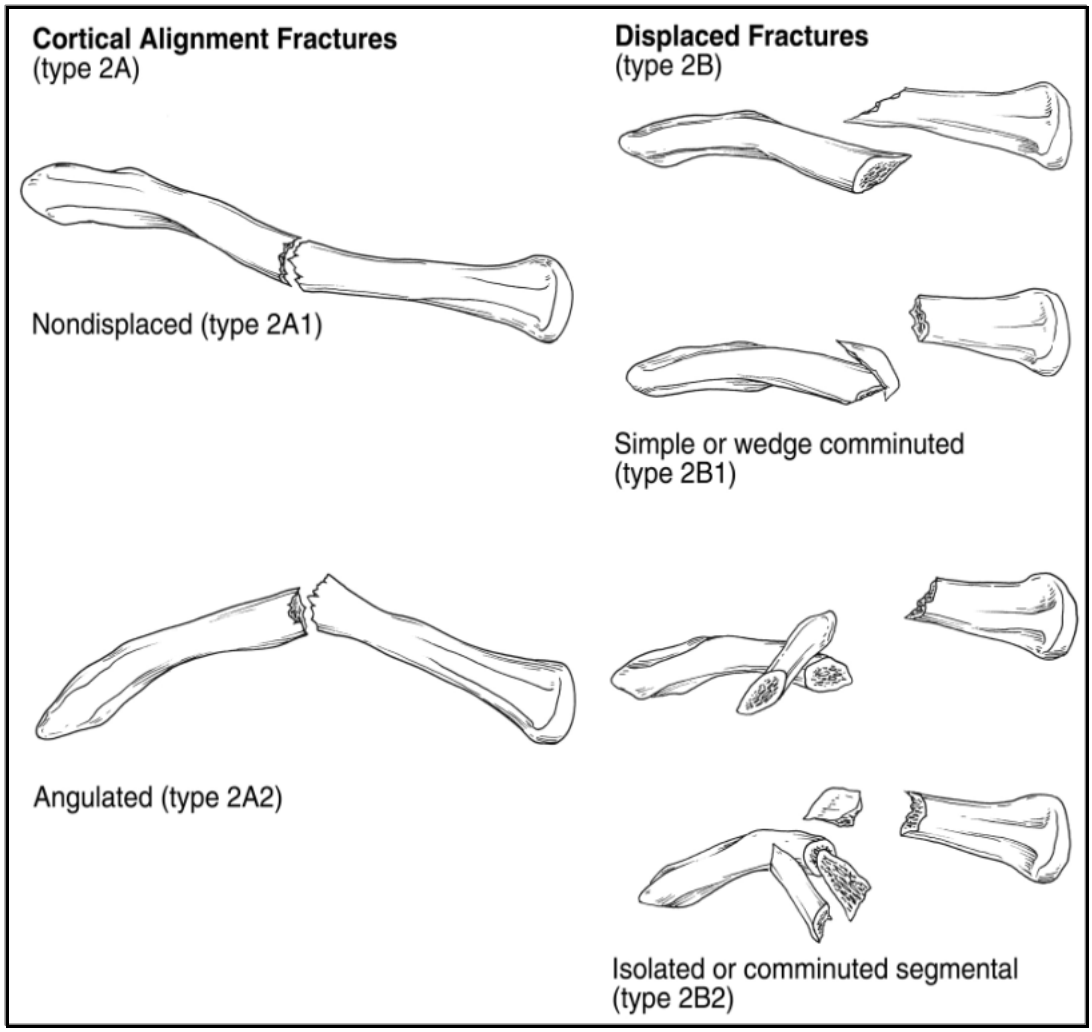
Type IV – Epiphyseal separation

Type V – Comminuted

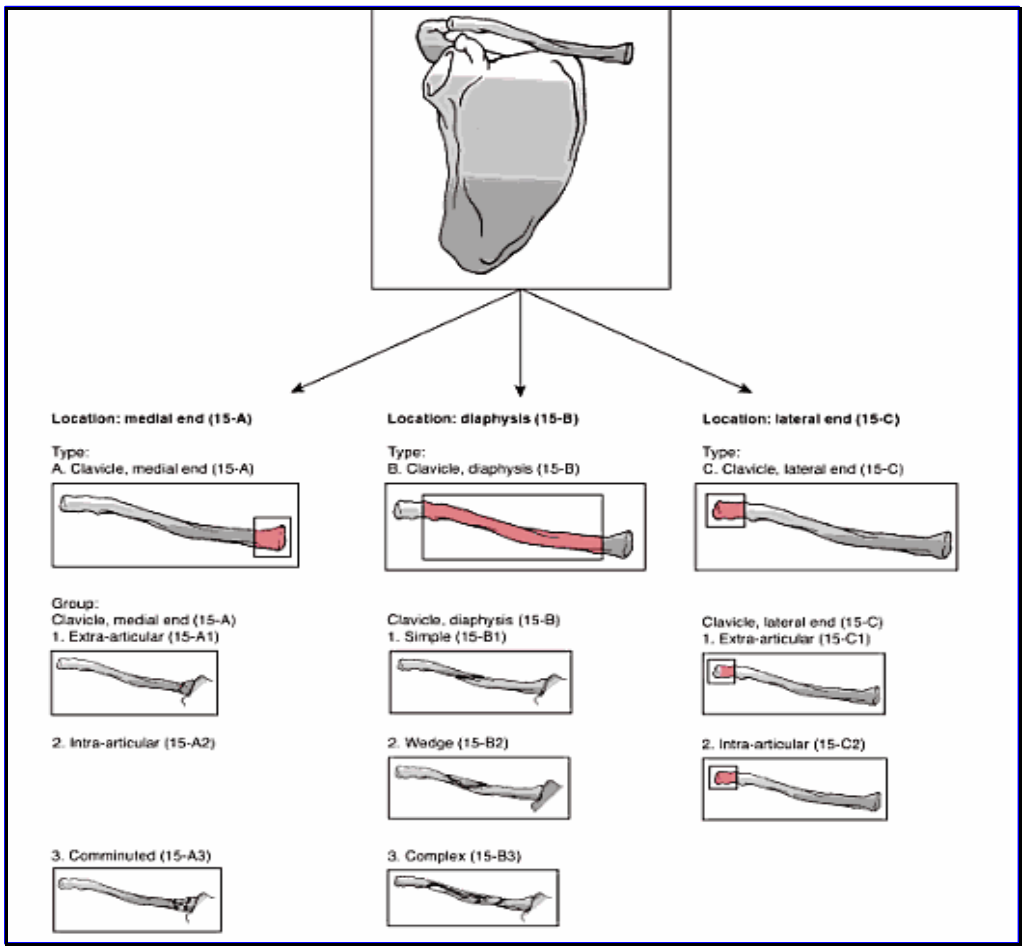
ROBINSONS CLASSIFICATION



ROBINSON CLASSIFICATION OF MIDSHAFT CLAVICLE



ORTHO TRAUMA ASSOCIATION CLASSIFICATION (OTA)



ASSOCIATED INJURIES:

Associated injuries accompany acute fracture of the clavicle. Itmay be divided into –

1) Associated skeletal injuries

2) Injury to lung and pleura

3) Vascular injuries

4) Brachial plexus injuries

- **Skeletal injuries** may include sternoclavicular or acromioclaviculardislocation or fracture dislocationof these joints.
- Head and neck injuries
- Fracture of the first rib
- Associated with dislocation – disruption of scapulothoracic articulation
- Fracture of both the clavicle and the scapula are associated with an extremely unstable shoulder girdle – floating shoulder.
- Pneumothorax, heamothorax occur with fractures of the clavicle because the apical pleura and upper lung lobes lie adjacent to this bone.
- **Vascular injuries** include laceration, occlusion, spasm or acute compression. The vessels most commonly injured are the subclavian artery, subclavian vein and internal jugular vein.

- Brachial plexus injury in clavicle fractures are often associated with subclavian vessel injury muscle.

RADIOGRPAHIC EVALUATION

A) Evaluation of clavicle middle third clavicle fractures:

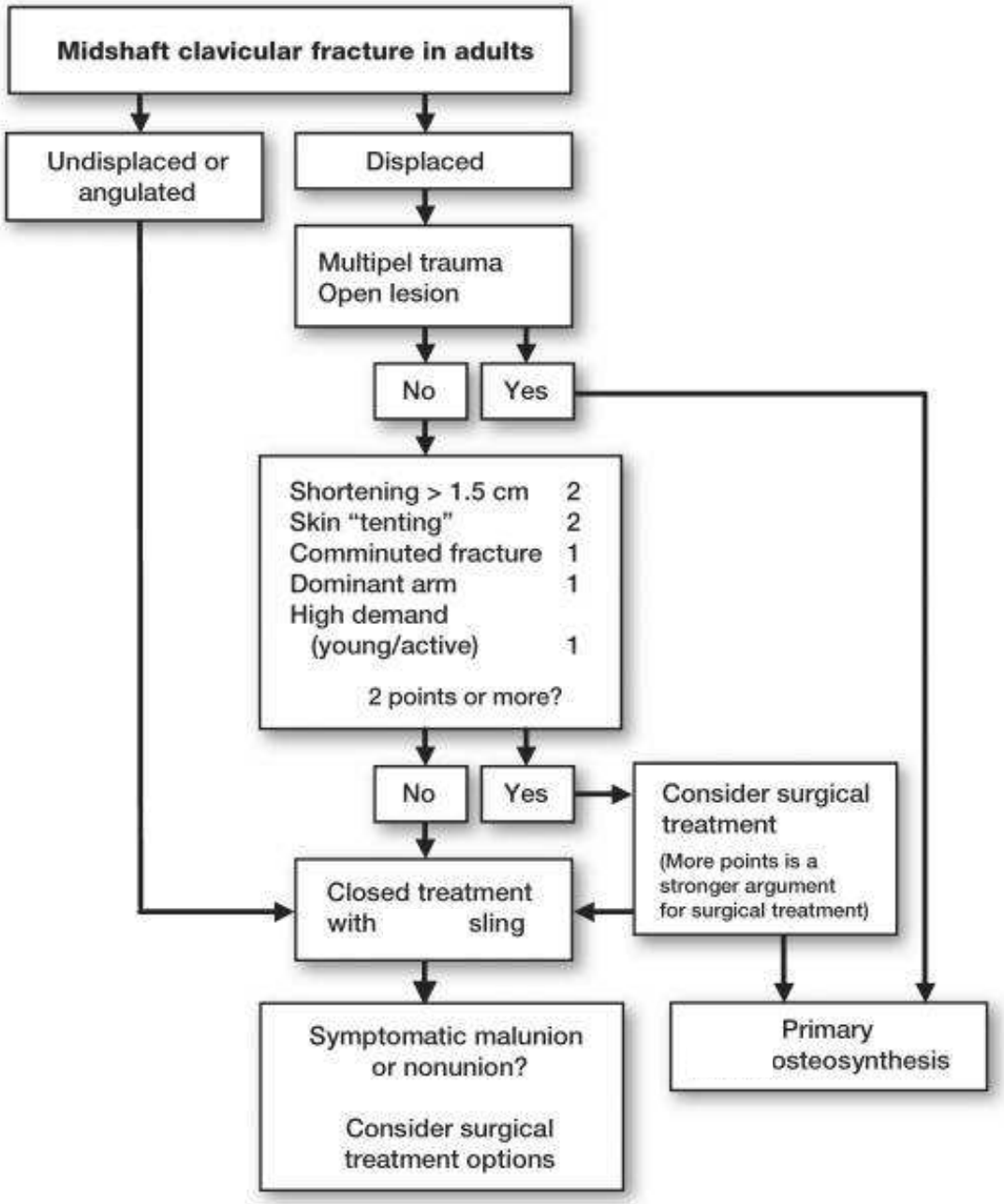
The clavicle not only shortens but also become angulated inferiorlyand rotated medially and the deformity is truly in two planes. To obtain an accurate evaluation of fragment position at least two projections of the clavicle should always be obtained – Ananteroposterior view and a 45 degrees cephalic tilt view.

In patients with minimal displacement of the fracture fragments and with no gross motion tomography or even bone scan may be useful to demonstrate the presence of non-union in asymptomatic patients.(40)

TREATMENT

Several factors like the age, medical condition of the patient, the location of the fracture and associated injuries determine the method of treatment of a fractured clavicle. It is important to achieveanteroposterior and lateral alignment of the fracture.

As with any other fracture the goal of treatment is to achieve healing of bone with minimal morbidity, loss of function and residual deformity.



General methods of treatment of fractures of the clavicle can be broadly grouped into the following

- Conservative or non-operative treatment.
- Operative treatment.

NON-OPERATIVE TREATMENT:

The main principles of non-operative treatment historically have included the following points.

1) Bracing of the shoulder girdle to raise the outer fragment upward, outward and backward.

2) Depression of the inner fragment.

3) Maintenance of reduction.

4) Use of ipsilateral elbow and hand so that associated problems with immobilization can be avoided.

Methods used:

i) Figure-of-eight bandages

ii) Broad arm sling.

TREATMENT BY FIGURE-OF-EIGHT BANDAGES :

The patient sits on a stool the operator standing behind with his knee between the patient shoulder blades over lay pads of cotton in eachaxilla. Domette bandage 15cm wide are bound in front of the shoulder and cross between the shoulder blades in such a way that both shoulders are braced back. The limb is supported by a triangular slingunder the elbow and forearm. Although figure-of-eight bandaging is

a universal and time honoured treatment for fractures of the clavicle it should not be used as a routinein every case.

Advantages:

The figure-of-eight bandages allows the arm to remain free and can be used to a limited degree.

Disadvantages:

It needs frequent readjustment and it causes increased discomfort.

Complications:

Include axillary pressure sores, upper extremityedema and venouscongestion, brachial plexus palsy, worsening of deformity and increasedrisk for nonunion.(23)

SLING METHOD:

Sling treatment is certainly simplest way to treat a fractured clavicle by placing the arm in a sling with the forearm across the abdomen.

Disadvantages :

i) The position of forearm may exaggerate the shortening of the fracture and anteromedial rotation of the scapula.

ii) In this method of treatment free usage of arm is not possible(2).

OTHER METHOD:

Multiply traumatized patient with clavicular fracture can be treated by recumbency. A small pillow is placed between the scapula to allow the weight of the arm to reduce the fracture and use of a sling may make the arm more comfortable. Conservative management does not equate with neglect in fact in many ways conservative management of fractures in general is more time consuming and labour intensive than operative management.(23)

OPERATIVE TREATMENT:

The chief goal in this method of treatment is to achieve a healedclavicular strut in an normal anatomical position. The healed clavicular bone in good position provides stability to the shoulder girdle.

It may be by any of this methods.

i) Intramedullary fixation

ii) Internal fixation with plates and screw.

iii) External fixation.

Indication:

Indications for operative treatment of clavicular fractures are.

1. Displacementgreater than 2cm, increasingcomminution greater than 3 fragments(34)
2. Shortening greater than 2 cm.(34)

3. Neurovascular injury or compromise that is progressive or that fails to revere after the closed reduction of the fracture.(35)

4. Open fracture with impending soft tissue compromise

5. Segmental fractures(34)

6. Multiple traumas, when mobility of the patients is desirable and closed methods of immobilization are impractical or possible.

7. Bilateral clavicle fractures and ipsilateral upper rib fractures.(34)

8. Floating shoulder.(34)

9. Progressive neurological deficit(34,35)

10. Cosmetic reasons and patient motivation for rapid return to work.

INTRAMEDULLARY DEVICES:

Before the advent of AO/ASIF techniques, the smaller thin plates that were used gave poor results leading many to prefer intramedullary fixation with smooth or threaded Kirschner wires, steinman pins, knowles pins, Hagie pins, or cannulated screws, wires or screws.

Advantages:

- It can be performed **closed** or through small skin incision (34).

- It requires minimal soft tissue stripping and can be removed under local anaesthesia.
- Decreased hardware prominence
- Lower incidence of refracture or fracture at the ends of implants(34)
- In setting of comminution the cantilever effect for a pin extends tomedial most portion of the pin there by providing better fixation in bending loads. It allows axial compression so it enhances healing.

Disadvantages:

Failure to control axial length and rotation especially with increasing fracture communition.(34)

Intramedullary fixation of the clavicle is technically very difficult owing to the curvature, high density and poorly defined intramedullary canal of the bone.

II PLATE AND SCREWS:

Biomechanically plate fixation is superior to intramedullary fixation because it better resists the bending and torsional forces that occur during elevation of the upper extremity above shoulder level.

Advantages:

1. In transverse fractures, compression across the fracture site is achieved.

2. In oblique fractures or butterfly fragments, lag screw fixation is possible with the plate functioning in a neutralization mode.

3. Rotational control of the fracture in achieved.

4. Rigid fixation Fixation.

Disadvantages:

- Increased exposure and soft tissuestripping.
- Potential damage to the supraclavicular nerves which crossthrough the surgical field.
- The plate itself sits subcutaneous and can be the source of irritation and poor cosmosis.
- Another procedure is required for plate removal.

III. EXTERNAL FIXATION:

It may he indicated for severe open fracture with poor quality of the overlying skin and infected non union after plate removal.

Practical difficulties associated with the position and prominence of the fixation pins. poor patient acceptance resulted in minimal use .

COMPLICATIONS

A) MALUNION:

Adults have noremodeling potential so shortening or angulationmay occur after displaced clavicular fractures. Patients with shortening of the clavicular segment of more than **2cm** at follow-up examination had significantly more pain than those without these findings(8)

B) NON-UNION :

- Clavicular non-union is defined as lack of radiographic healing at 6 months post injury.
- The incidence of non-union probably much higher than previously thought with an incidence of 15% to 25%.(36)
- Factors predispose to non-union of the clavicle are –
  Fracture shortening of ≥20 mm(34,37)
  Fracture displacement of >20 mm(38)
  Increasing patient age(39)
  Increasing severity of trauma
  Refracture andsoft-tissue interposition

c) Neurovascular sequelae :

In adults late neurovascular sequelae can follow both united and ununited fractures. Abundant callus or significant fracture deformity in some patients may narrow the costoclavicular space sufficiently to cause

symptoms which most frequently involve the subclavian and axillary vessels or the brachial plexus (especially the ulnar nerve).

D) POST TRAUMATIC ARTHRITIS :

It may follow after intraarticular injuries to both the sternoclavicular and acromioclavicular joints. Often this is a result of an unrecognized intra articular fracture 1,28

COMPLICATIONS OF SURGERY AND ITS TREATMENT :

1) Hard ware problems :

As with fresh fracture fixation inadequate purchase or plate size, collapse of the intercallary graft are important predictors of failures like plate loosening, plate angulation, plate breakage which may be treated by replating. In case of perfect transverse fracture the point of fixation of the cantilever is the sternoclavicular joint and the plate acts to compress the fracture with bending. In most high energy clavicle fractures are comminuted and in this setting the fixation point of the cantilever moves laterally to the fracture site and putting significant force on the lateral most screws so the plate fail by pullout of the lateral most screws.

2) Infection :

Infection after operative treatment for fracture or non-union can be a devastating complication. Reconstruction for deep infection or osteomylitis particularly in the non-union situation where bone loss my

be extensive is often difficult. Initial treatment should include operative debridement. Although consideration can be given for retaining a stable graft. If hardware configuration is unstable treatment should include removal of all graft and hardware followed by 6 weeks of intravenous antibiotics. Revision surgery can be undertaken once clinically apparent infection is aborted. If there is a major bone loss vascularized graft maybe needed.

3) Hypertrophic scar:

The potential for a hypertrophic uncosmetic scar after open plating is common. The remedy is scar excision at the time of plate removal.

4) Refracture :

Initial comminuted fracture is a risk factor for subsequent refracture.

5) Non union, delayed union and malunion :

It can be treated by replating and bone grafting. (28,32,33)

MATERIALS AND METHODS

This is a prospective study carried out from May 2010 to December 2012 at the Institute of Orthopaedics and Traumatology, Rajiv Gandhi Govt. General Hospital, Madras Medical College Chennai. 20 patients admitted with displaced midshaft clavicular fractures during this period were treated with Titanium Elastic Nail and were studied for the functional outcome, complications and fracture union.

INCLUSION CRITERIA:

1. Age above 15years .
2. OTA type A and B fractures
3. Displaced closed clavicle fractures
4. Fractures with imminent skin perforation
5. Floating shoulder injuries
6. Polytrauma with ipsilateral rib fractures

EXCLUSION CRITERIA:

1. Age less than 15 years
2. Compound fractures
3. OTA type C fractures
4. Lateral and medial end clavicle fractures
5. Uncooperative patient for post operative rehabilitation

General information like Name, Age ,Sex, Occupation and Address were noted.

Mode of injury like direct injury, fall on an outstretched hand, Road traffic accident were recorded.

History of Past medical illness was noted.

General examination; anaemia, jaundice, lympadenopathy, pulserate, blood pressure noted. Respiratory,Cardiovascular and Neurological examined.

LOCAL EXAMINATION:

Inspection:

1. Patients with fracture clavicle often support the flexed elbow of the injured side with the other hand
2. Skin condition over clavicle is noted for any abrasion and laceration.
3. Shortening

Palpation:

1. Entire length of clavicle palpated.
2. Crepitus and Abnormal mobility observed.
3. Adjacent Sternoclavicular and Shoulder joints examined.
4. Thoracic cage and Scapula palpated to rule out fractures

Movements:

Movements of the affected side shoulder was restricted due to pain

The distal neurovascular status of the affected upper limb was examined.

Plain radiographs of clavicle, anteroposterior view and 45degree cephalic tilt view was taken to assess the site of fracture, type of fracture, displacement of fracture and comminution. The fracture was classified according to OTA (Ortho Trauma Association) and Robinson's classification. Affected arm immobilized with arm-sling.

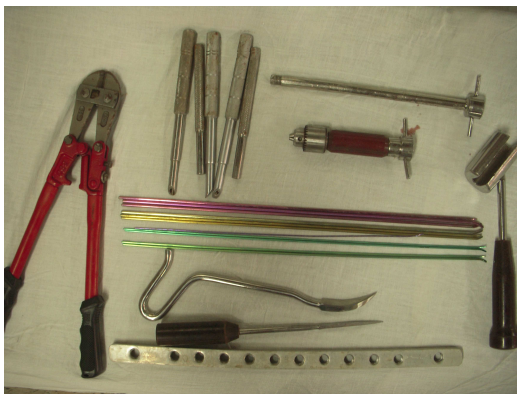
Routine investigations complete haemogram, renal function test, ECG and Chest X-ray were done.

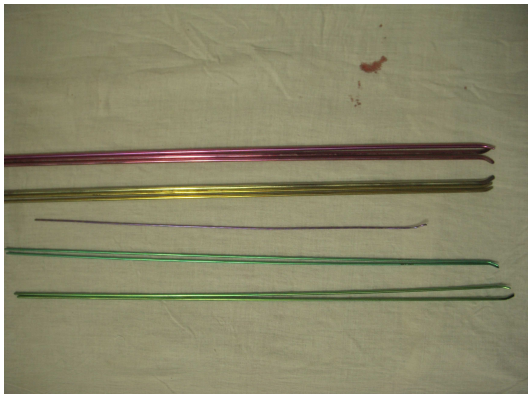
All the patients were operated on as early as possible once the general condition of the patient were stabilized

Preoperative preparation of patients;

- Fasting for 8 hours before surgery
- Neck, chest, axilla, shoulders and arm were prepared.
- A written informed consent for surgery was taken.
- Inj.cefotaxim 1gm intravenously were administered 30minutes before surgery

All patients were operated under general anaesthesia.





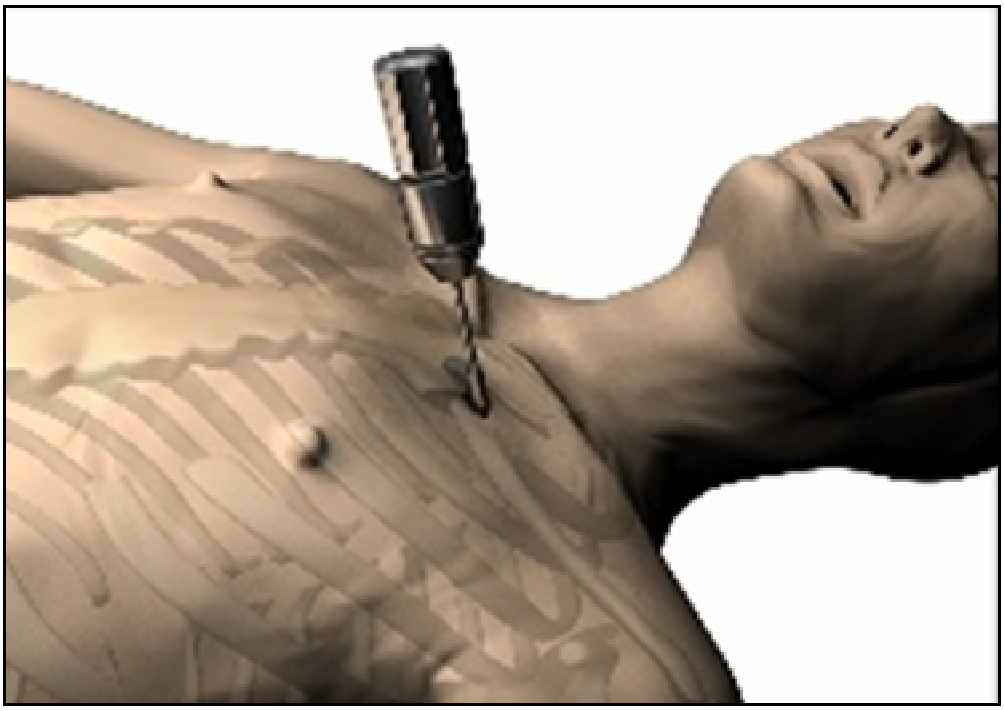
TECHNIQUE OF TITANIUM ELASTIC NAIL FIXATION

- Patient in supine position with sandbag under interscapular region in a radiolucent table.

- Entire upper limb from base of neck to hand were prepared and draped with free range of motion of the arm.

- Small incision of 1-1.5 cm is made lateral to the sternal end of the clavicle. Skin, subcutaneous tissue and platysma were divided (Step-1).

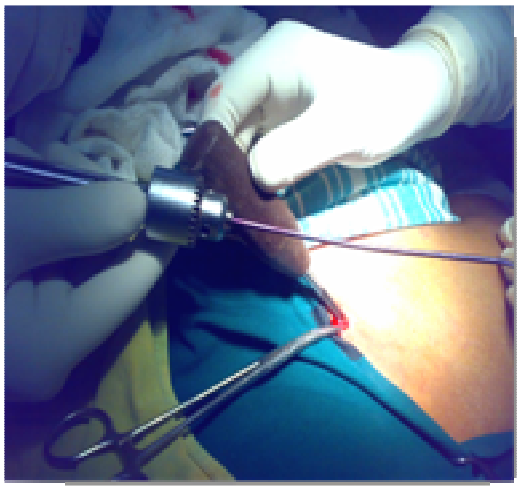
- The anterior cortex is opened at an angle of 30 degree to horizontal plane after soft tissue dissection with an awl or a drill bit (Step-2).



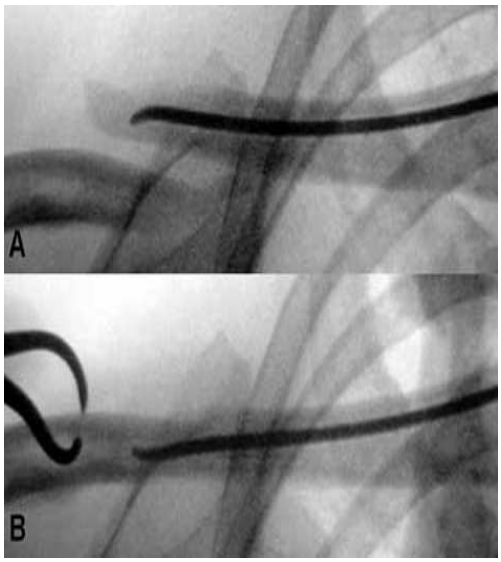
- A flexible titanium nail of appropriate size on a Jacob's chuck is advanced in the medullary canal manually (Step-3).

- With image intensification, the implant is advanced to the fracture site. When the tip reaches the fracture, reduction is performed manually or percutaneously by means of a reduction clamp, inserting the nail into the lateral fracture fragment. If this does not succeed, the tip of the nail is introduced under direct view after performing a second small (2–3-cm) skin incision directly over the fracture site.

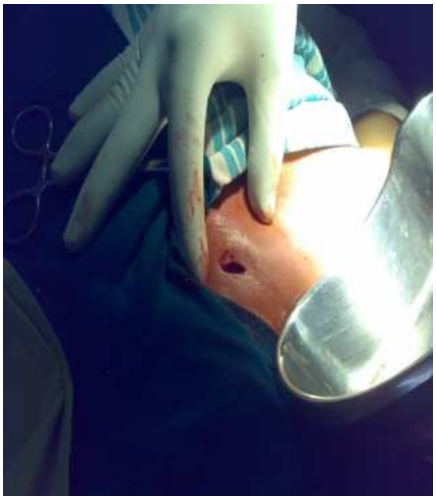
Step-1 & Step-2

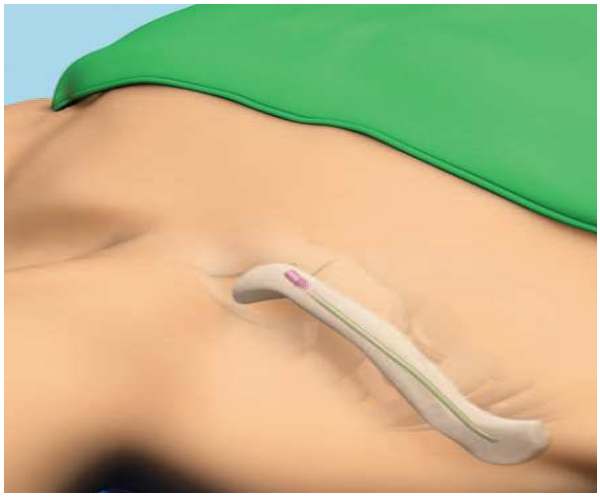


Step-3



Step-4





- The nail is then advanced manually or gently tapped with a hammer until it is just medial to the AC joint.

POSTOPERATIVE PROTOCOL:

- Patients were kept nil by mouth for 6 hours post operatively.
- Intravenous fluids and antibiotics were given as needed.
- For postoperative pain control, a sling is given for a few days.
- Check x-rays were taken to study the alignment of fracture fragments.
- Wound was inspected on 3rd post-operative day.
- Shoulder movements other than overhead abduction and 5flexion initiated from 2nd post operative day.
- Active movements of the shoulder (over 90° abduction or flexion) should be limited for 6 weeks.
- Nail removal after 12 weeks post-op following union.

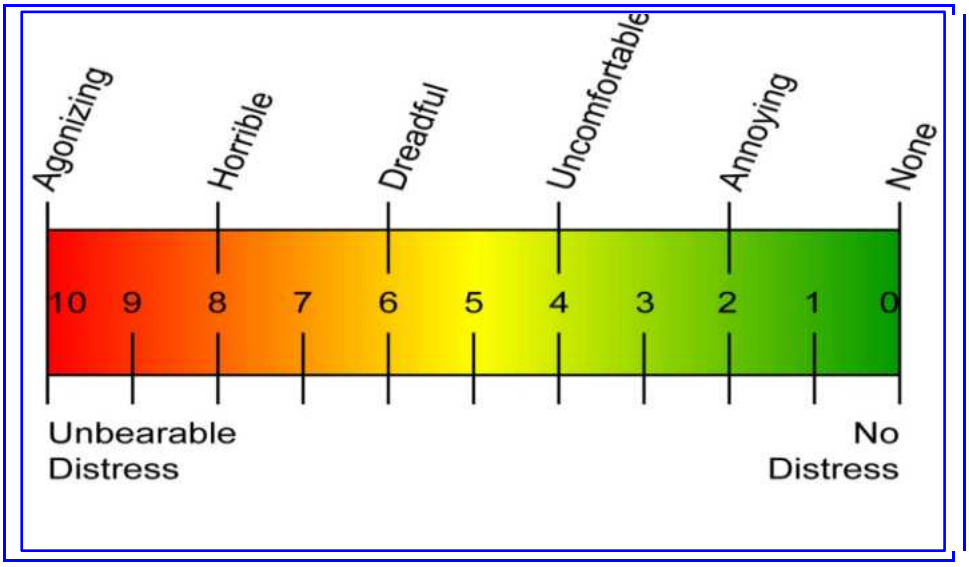
FOLLOW UP:

- Regular follow up for every 4 weeks upto 5 months was done
- Affected clavicle examined clinically and radiologically to know about implant position and fracture union.

- Rehabilitation of affected side done sequentially according to stage of fracture union.

- Functional out come assessed by VAS (visual analogue scale),Constant-Murley score.

VISUAL ANALOGUE SCALE



The score is determined by measuring the distance (mm) on the 10-cm line between the “no pain” anchor and the patient’s mark, providing a range of scores from 0–100.(41)

- 0–4 mm - No pain,

- 5–44mm - Mild pain,

- 45–74 mm - Moderate pain, and

- 75–100 mm - Severe pain (41).

The functional outcome were assessed by Constant and Murleyscore (.35,36)

CONSTANT AND MURLEY SCORING:

The patients are graded as follows

CATEGORY:

A) SUBJECTIVE :

1) Pain - 15 Points

No pain	15
Bearable pain	10
Disabling pain	5

2) Activities of daily living : - 20 Points

Ability to perform full work	04
Ability to perform Leisure activities/Sports	04
Unaffected sleep	02

Level at which work can be done :

Up to Waist	02
Up to Xyphoid	04
Up to Neck	06
Up to Head	08
Above head	10

B) OBJECTIVE :

RANGE OF MOVEMENTS : 40 POINTS :

a) Active flexion without pain

00 to 30 Degrees :	0
31to60 Degrees :	2
61to90 Degrees :	4
91to120 Degrees :	6
121to150 Degrees :	8
> 151 Degrees :	10

b) Functional external rotation :

Hand behind head with elbow forwards	2
Hand behind head with elbow backwards	4
Hand above head with elbow forwards	6
Hand above head with elbow backwards	8
Full elevation from on top of head	10

c) Active abduction without pain :

With dorsum of hand on back, head of third metacarpal reaches

00 to 30 Degrees	0
31to60 Degrees	2
61to90 Degrees	4
91to120 Degrees	6
121to150 Degrees	8
> 151 Degrees	10

d) Functional internal rotation :

Ipsilateral buttock : 2

S1 spinous process : 4

L3 spinous process : 6

T12 spinous process : 8

T7 spinousprocess : 10

e) Strength of abduction : 25 Points

A normal shoulder in a 25 year old man resists 25 pounds without difficulty. The score given for normal power is 25 points, with proportionately less for less power. Patients were graded as below with a maximum of 100 points.

Total score	**Result**
90-100	Excellent
80-89	Good
70-79	Fair
0-70	Poor

RESULTS AND OBSERVATIONS

The present study consists of 20 cases of displaced mid-shaft clavicle fractures who qualified for the study according to our inclusion criteria. They were treated with Titanium Elastic Nail between May 2010 to May 2012. No potential candidate refused to enter the study by preferring nonoperative treatment. All the patients were available for follow-up and they were followed every 4 weeks for a period of 6 months . Results were analyzed both clinically and radiologically.

MODE OF INJURY:

Table-1.

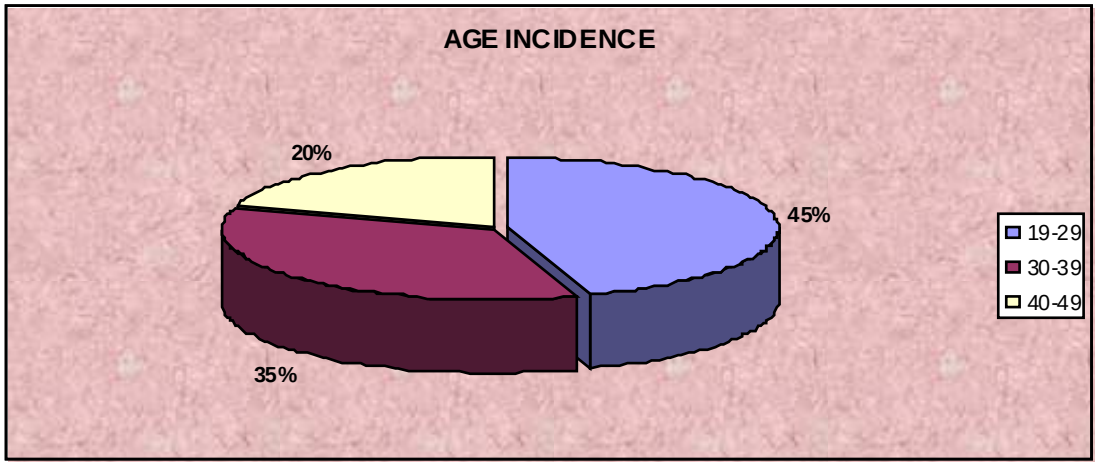
	No of patients	Percentage
Road traffic accident	12	60%
Fall from height	4	20%
Fall on outstretched hand	4	20%
Total	**20**	**100%**

Of the 20 patients 12 patients (60%) fracture occurred due to road traffic accident,4 (20%)patients sustained fracture due to indirect injury, fall on outstretched hand and 4patients(20%) due to fall from height. in all the patients fractures were closed type .

AGE INCIDENCE:

Age in years	No of patients	Percentage
19-29	9	45%
30-39	7	35%
40-49	4	20%

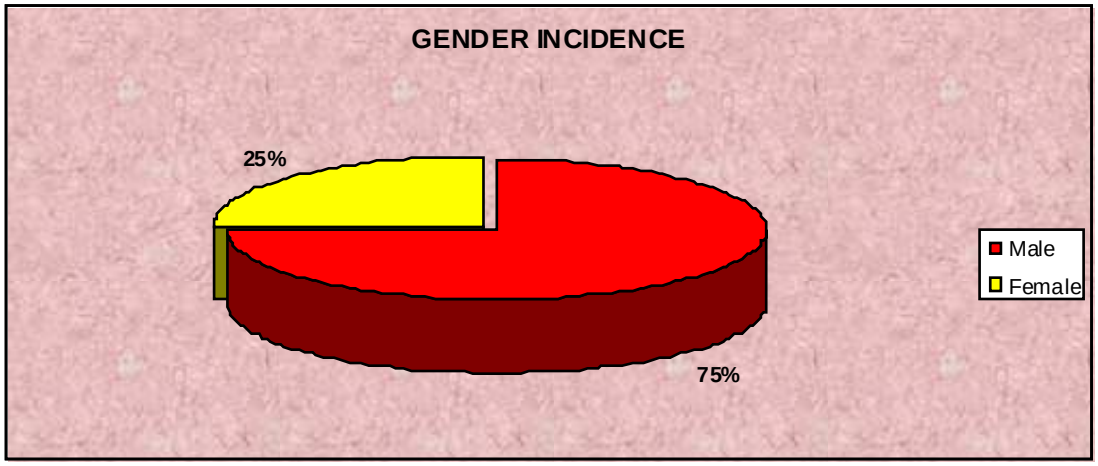
Majority of patients in our study 9 patients (45%)were in the age group of 19-29 years, 7 patients (35%) in 30-39 age group. And 4 patients (20%) in 40-49 age group. Youngest patient in our study was 19 years old and oldest patient in our study was 45 years. The average age was 32 yrs (range from 19 to 49).



GENDER INCIDENCE:

Gender of patient	No of patients	Percentage
Male	15	75%
Female	5	25%

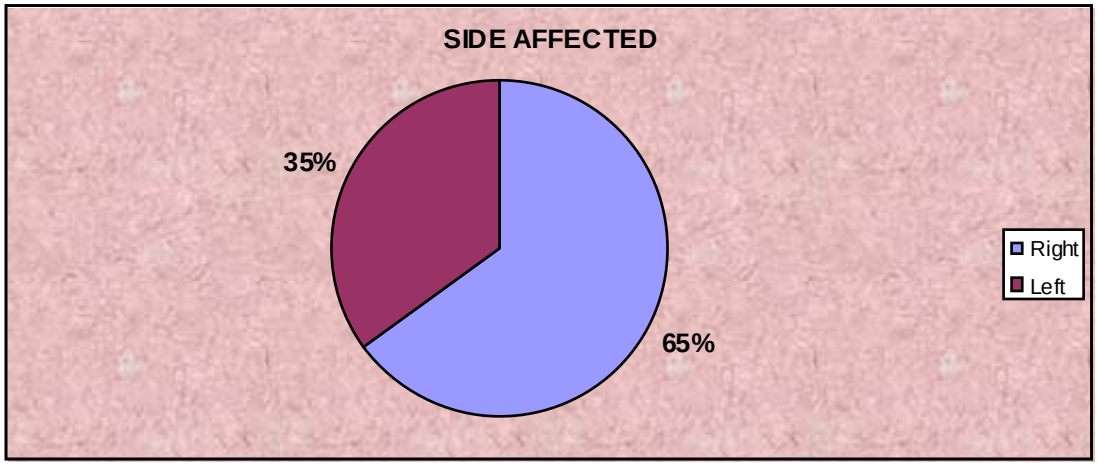
In our study majority 15 patients(75%) were males and 5 patients (25%) were females.



SIDE AFFECTED:

Side	No of patients	Percentage
Right	13	65%
Left	7	35%

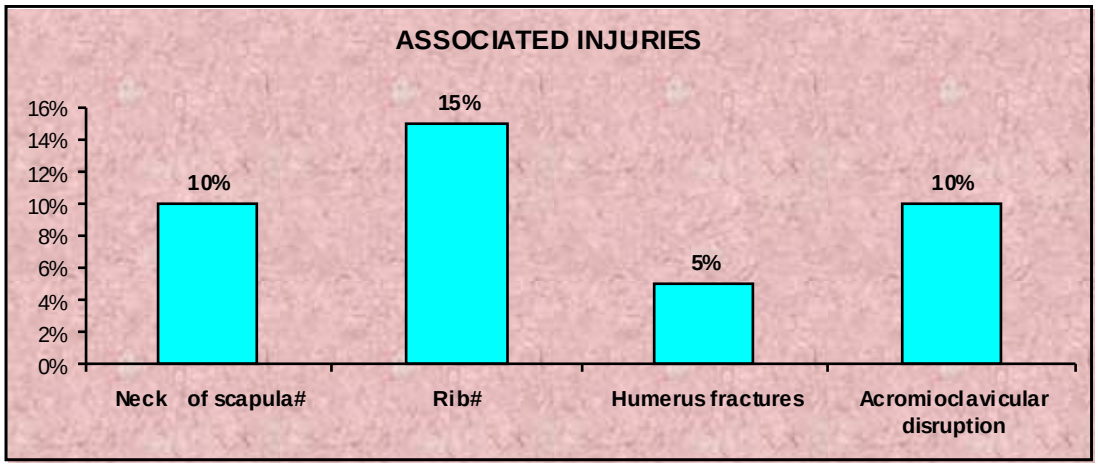
In this study 13 patients(65%) had right side fracture and 7 patients(35%) had left side fracture.



ASSOCIATED INJURIES:

Type	No of patients	Percentage
Neck of scapula#	2	10%
Rib#	3	15%
Humerus fractures	1	5%
Acromioclavicular disruption	2	10%

2 patients (10%) had neck of scapula #,3 patients had rib# without haemo or pneumothorax .1 patient (5%) patient had closed humeral shaft fracture. 2 patients (10%) had Acromioclavicular disruption on the contralateral side.

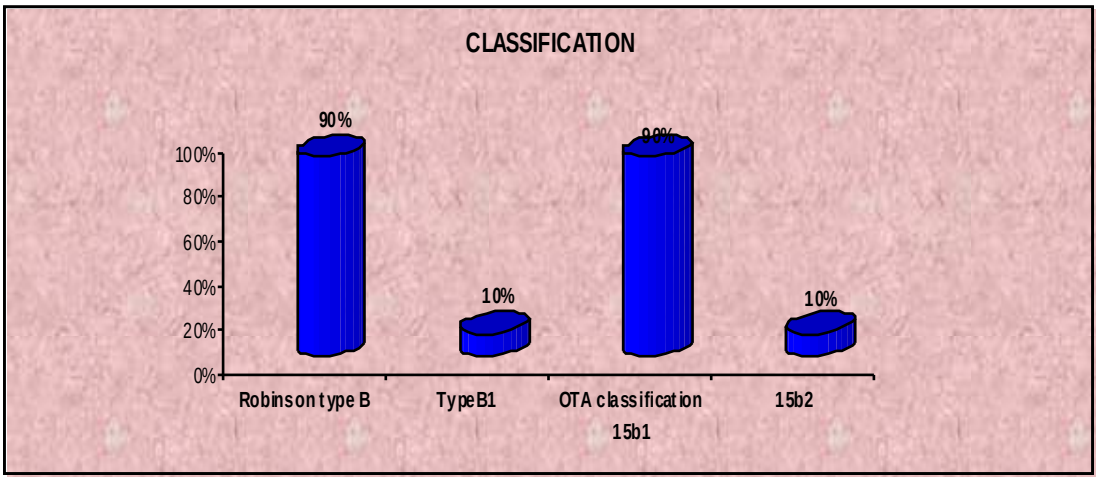


CLASSIFICATION:

Plain radiograph antero-posterior view with shoulder to asses the fracture pattern (like displacement, angulation, communition) .in our study OTA (ortho trauma association) and Robinson classification was followed.

Classification	No of patients	Percentage
Robinson type B	18	90%
TypeB1	2	10%
OTA classification		
15b1	18	90%
15b2	02	10%

18 patients (90%) in our study were Robinson Type B and 2 patients (10%) were Robinson type B1.18 patients (90%)classified as OTA type 15b1 and 2 patients (10%) had OTA type 15b2.



Pre-operative shortening and Displacement

Shortening	No of patients	Percentage
1.5 to 1.9cm	12	60%
2cm to 2.5	8	40%

Length of clavicle on the affected side measured from suprasternal notch to Acromioclavicular joint and compared with normal side for any shortening.

12 patients (60%) had 1.5 to 2cm shortening and 8 patients (40%) had shortening 2to 2.5cm with average shortening of 1.92cm.

Displacement was measured radiologically. All patients included in the study had displacement >2cm, average displacement 2.2 cm

TIME INTERVAL FOR SURGERY:

Time of surgery	No of patients	Percentage
Within 24 hrs	4	20%
2-7days	13	65%
7-14 days	3	15%

All patients were operated once the general condition of the patients were stable 4 patients (20%) were operated in day one 13 patients (65%) were operated from 2-7 days. 3 patients (15%) were operated from 7-14 days. The operative treatment was performed an average of 4 days (range: from 1 to 14 days)

TYPE OF IMPLANT USED

TENS system	No patients	Percentage
1.5mm	5	25%
2mm	15	75%

SURGICAL TECHNIQUE:

Nature of surgery	No of patients	Percentage
Closed	5	25%
Mini open	15	75%

All 4 patients (20%) patients operated within 24 hours were by mini open technique due to non availability of C –arm.5 patients out of 13 patients operated from 2-7 days were operated by closed method in elective operation theatre, remaining 8 patients were operated by mini-open technique. All 3 patients operated on 7- 14 days were mini open technique since closed reduction was not possible .

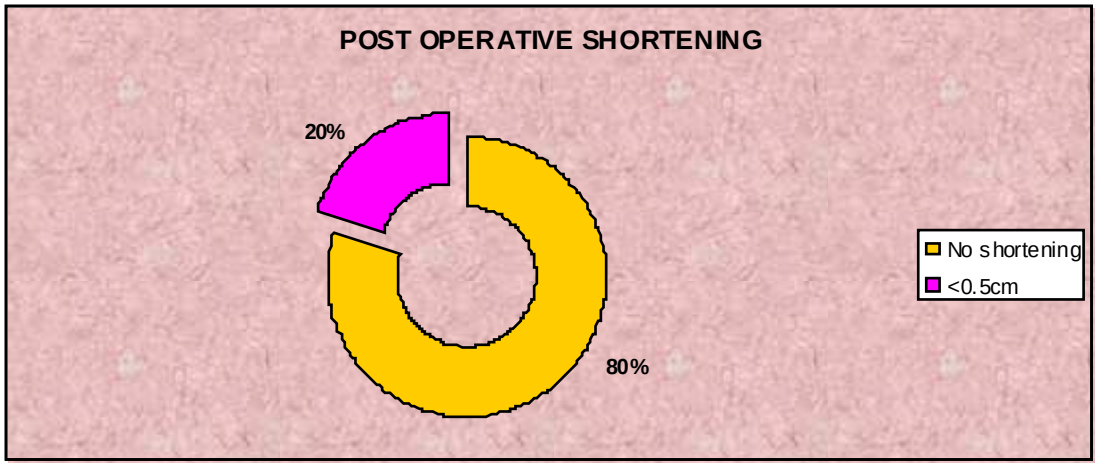
Post op visual analogue scale:

Pain measured with visual analogue scale the score averaged 1.5±0.5.

POST OPERATIVE SHORTENING

Shortening in cm	No of patients	Percentage
No shortening	16	80%
<0.5cm	4	20%

Pre operatively all 20 patients had shortening with average shortening of 1.92cm.post operatively 16 patients (80%) had no shortening, and 4patients(20%) had <0.5cm shortening with average shortening of 0.3cm.



DURATION OF UNION

The fracture was considered to be united when clinically there was no tenderness, radiologically the fracture line was not visible and full unprotected function of the limb was possible.

Time of union	No of patients	Percentage
8-12 weeks	17	85%
>12 weeks	3	15%

In 17 patients (85%) fracture united by the end of 12th week post operatively. 3 patients (15%) patients fracture united by 16-18 weeks. All 3 patients were above 40 years and 2 patients had Robinson type B1 fracture.

FUNCTIONAL OUTCOME

Constant score	No of patients	Percentage
Excellent	12	60%
Good	7	35%
Fair	1	5%
Poor		0%

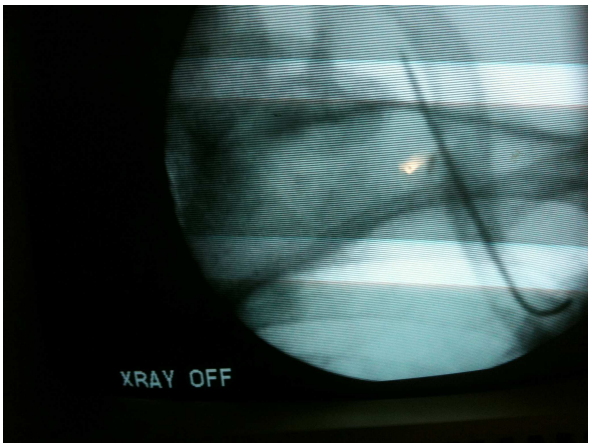
The Average Constant Murley Score was 93.05

COMPLICATIONS

2 patients had perforation of the dorsolateral cortex which was identified intraoperatively, and the nail was repositioned.

skin irritation due to prominent nail on the medial side occurred in 4 patients (20%). 4 patients required nail removal at 14 weeks fracture union was achieved by the time 1 patient (5%) had superficial skin infection after 5th postoperative day which settled with oral antibiotics.

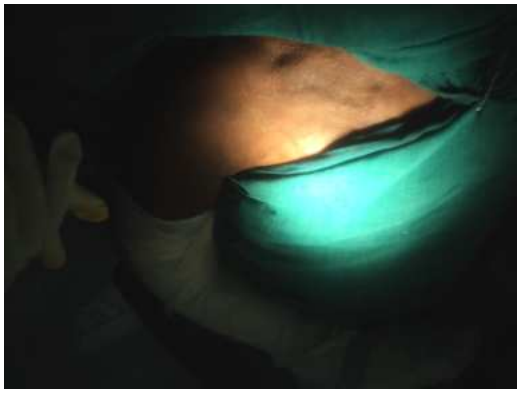
Peroperative dorsal cortex perforation



Prominent medial end producing skin irritation

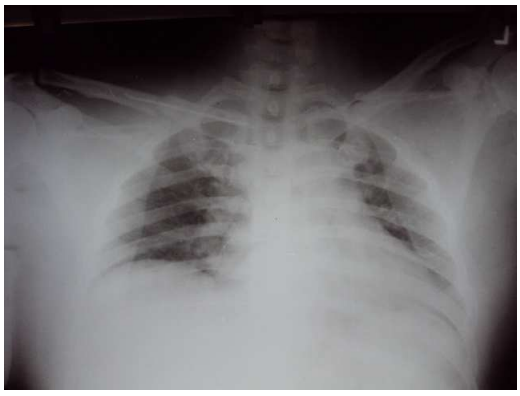
ILLUSTRATION CASE-I

Pre OP Positioning

Intra Operative


Post Operative X-Rays

Post Operative Functional Outcome

ILLUSTRATION CASE-II

Pre Operative

Post Operative

After implant exit

Functional Outcome

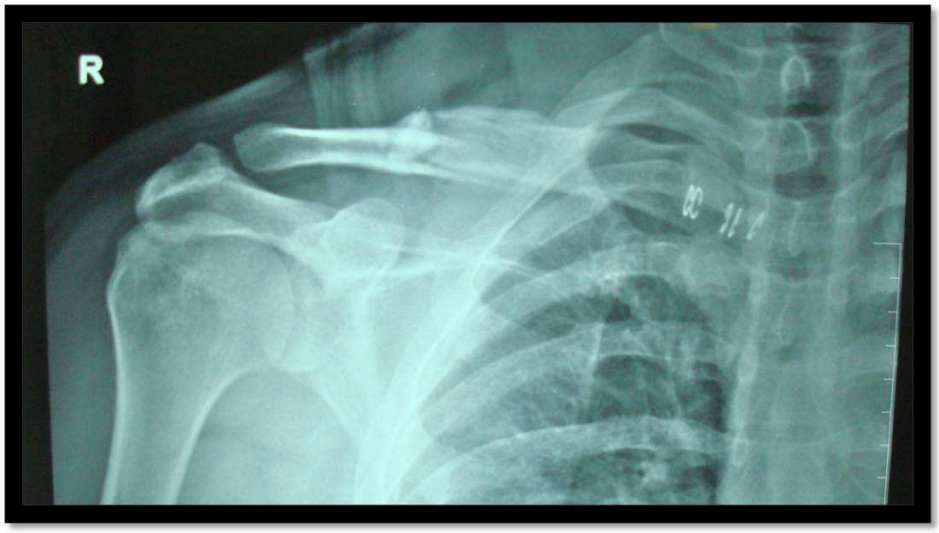
ILLUSTRATION CASE-III

Pre Operative

Post Operative

Six months followup

After Implant Exit



Functional Outcome

DISCUSSION

Usually clavicle fractures are treated conservatively. Hill et al 1997(8) and Mckee et al in 2006 found poor results following conservative management of displaced midshaft clavicle fractures.(9). Displaced fractures, fractures with initial shortening of >20 mm was associated with a greater risk of nonunion and a poor clinical outcome(8).

JUBEL*et al*. (16) showed that the correction of clavicular shortening is a prerequisite for good functional outcome. They observed no non union and no poor functional outcome in their study.Surgical procedures using platefixation have shown major complications such ashematoma, infections, implant failures and non-union, in comparison to conservative management Bostman et al(11).Minimally invasive ESIN was thus established as an alternativeto plate fixation.

Our study was conducted in 20 patients, and is a prospective study as compared to Hartman et al who retrospectively reviewed a consecutive series of 15 patients with displaced midclavicular fractures.

In our study of the 20 patients 12 patients (60%) fracture occurred due to road traffic accident,4 (20%)patients sustained fracture due to indirect injury, fall on outstretched hand and 4patients(20%) due to fall from height. in all the patients fractures were closed type

In Hartmann et al (15) study most injuries resulted from traffic accident 7(47%) and sports accidents 6(40%) and fall from height 2(14%).

In our study 9 patients(45%) were in the age group of 19-29 years, 7 patients (35%) in 30-39 age group. And 4 patients (20%) in 40-49 age group. Youngest patient in our study was 19 years old and oldest patient in our study was 45 years. The average age was 32 yrs (range from 19 to 49).

In Hartmann et al (15) study the average age was 36.7 years(range 15 to 65).

In our study majority 15 patients (75%) were males and 5 patients (25%) were females.

In Hartmann et all study 12 patients (80%) and 3 patients (20%) were females.

In our study 2 patients(10%) had neck of scapula #,3 patients had rib# without haemo or pneumothorax .1 patient (5%) patient had closed humeral shaft fracture. 2 patients (10%) had Acromioclavicular disruption on the contralateral side.

In Hartmann et all study 2patients (13%) had imminent skin perforation,1 patient 1patient (7%) had floating shoulder injury.

18 patients (90%) in our study were Robinson Type B and 2 patients (10%) were Robinson type B1.18 patients (90%)classified as OTA type 15b1 and 2 patients(10%) had OTA type 15b2.

In Hartmann et al study they have used OTA classification and 7 patients(46%) type A and 8 patients(54%) had type B fractures.

In our study12 patients(60%) had 1.5 to 2cm shortening and 8 patients (40%) had shortening 2to 2.5cm with average shortening of 1.92cm.

All patients included in the study had displacement >2cm ,average displacement 2.2 cm.

In Hartmann et al study the average displacement was1.25 diaphyseal width and clavicle shortening ranged from 1 to 3.5cm.

In our study 4 patients (20%) were operated in day one .13 patients (65%) were operated from 2-7 days.3 patients (15%) were operated from 7-14 days. The operative treatment was performed an average of 4 days (range:from 1 to 14 days)

In Hartmann et al study the operative treatment was performed an average of 6 days after trauma (range :from 2 to 29 days).

In our study 5patients(25%) patients 1.5mm and in 15 patients(75%) 2mm TEN nails were used.

In Hartmann et al study a TEN average diameter 2.5mm was used.

In our study 5patients (25%) the fracture were fixed by closed reduction and 15 patients (75%) open reduction was necessary.

In Hartmann et al study 3 patients (20%) the fracture were fixed by closed reduction and 12 patients (75%) open reduction was necessary.

In our study Pre operatively all 20 patients had shortening with average shortening of 1.92cm. Post operatively 16 patients (80%) had no shortening, and 4patients(20%)had<0.5cm shortening with average shortening of 0.3cm.

In Hartmann et al study post operative measurement was not taken in study.

In our study post operative visual analogue scale the score averaged 1.5 ± 0.5.

In Hartmann et al study post operative visual analogue score averaged 1.5±0.5

In our study 17 patients (85%) fracture united by the end of 12th week post operatively.3 patients (15%) patients fracture united by 16-18 weeks. All 3 patients were above 40 years and 2 patients had Robinson type B1 fracture

In Hartmann study complete consolidation of all fractures was observed radiologically after 12 weeks.

In our study the average constant murley score was 93.05 with 12 patients (60%) had excellent score 90-100, 7 patients(35%)had good score 80-89,1 patient (5%)had fair score .

In Hartmann study constant averaged 93.5+/-3.9

In our study 2 patient had perforation of the dorsolateral cortex which was identified intraoperatively, and the nail was repositioned. skin irritation due to prominent nail on the medial side occurred in 4 patients (20%), 4patients (20%) required nail removal at 14 weeks fracture union was achieved by the time.1 patient (5%) had superficial skin infection after 5th postoperative day which settled with oral antibiotics.

In Hartmann et al study no infection was observed.1 patient (5%) suffered acromion clavicular disruption during nail insertion. In our study 4 patients (20%) suffered skin irritation and 1 case of superficial infection which healed without any complication.

CONCLUSION

- The data of this study shows that the treatment of mid-shaft clavicle fractures treated with titanium elastic intramedullary nailing results in excellent functional outcome.

- This technique provides high bone union rate, good functional outcome, early shoulder pain relief and early functional recovery obtained with minimal complications.

- This procedure is less invasive and can be performed with small incision when compared to plate fixation. But in communited fractures this can lead to telescoping and fracture heals with shortening. This is procedure is best suitable only for non communited midshaft clavicle fracture.

- Randomized controlled trials with adequate follow-up are required o determine the optimal surgical method to treat mid clavicular fractures.

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ANNEXURE-I

PROFORMA

Case No : Hospital :

Name :I.P.No. :

Age : D.O.A. :

Sex : D.O.D. :

Address : Occupation :

DIAGNOSIS :

I) HISTORY :

Complaints : Pain

Swelling

Duration

Side

Mode of injury: Fall on to the shoulder

Direct injury to the shoulder

Fall on outstretched hand

II) PAST HISTORY ;

III) FAMILY HISTORY :

IV) GENERAL PHYSICAL EXAMINATION :

Pallor

B.P.

P.R.

Temp.

125

V) SYSTEMIC EXAMINATION :

CVS

RS

P/A

CNS

VI) LOCAL EXAMINATION :

i) Inspection :

Attitude

Swelling

Deformity

Skin

ii) Palpation :

Local rise of temperature

Tenderness

Bony irregularity

Crepitus

iii) Movements :

iv) Neurovascular status :

v) Associated injuries

vi) Complications (if any)

VII) MANAGEMENT :

A) Investigations :

1) Blood :Hb% 2) Urine : Albumin

TC Sugar

DC Deposit

ESR

3) Blood urea : 4) HIV

Blood sugar: HBsAg

S.creatinine: 5) ECG

6) X-ray clavicle with shoulder AP view

B) Treatment :

i) Surgical procedure

ii) Indication

iii) Date of surgery

iv) Type of Anaesthesia

v) Implant used

vi) Antibiotics used

vii) Immobilization after surgery

- Type

- Duration

viii) Check x-ray :

ix) Rehabilitation :

VIII) COMPLICATIONS :

IX) FOLLOW UP :

1st month 2nd month 3rd month

Pain

Deformity

Movements of shoulder girdle

X-ray findings

X) ASSESSMENT OF RESULTS :

By Constant and Murley scoring system grading is done as follows

Total score Result

90-100 : Excellent

80-89 : Good

70-79 : Fair

0-70 : Poor

ANNEXURE - II

CONSENT FORM FOR OPERATION/ANAESTHESIA

I _____ Hosp. No._____ in my full senses

hereby give my complete consent for _____ or any other procedure deemed fit which is a diagnostic procedure / biopsy / transfusion / operation to be performed on me / my son / my daughter / my ward _____ age _____ under any anaesthesia deemed fit.

The nature and risks involved in the procedure have been explained to me to my satisfaction. For academic and scientific purpose the operation/procedure may be televised or photographed.

Date :

Signature/Thumb Impression
of Patient/Guardian

Name :

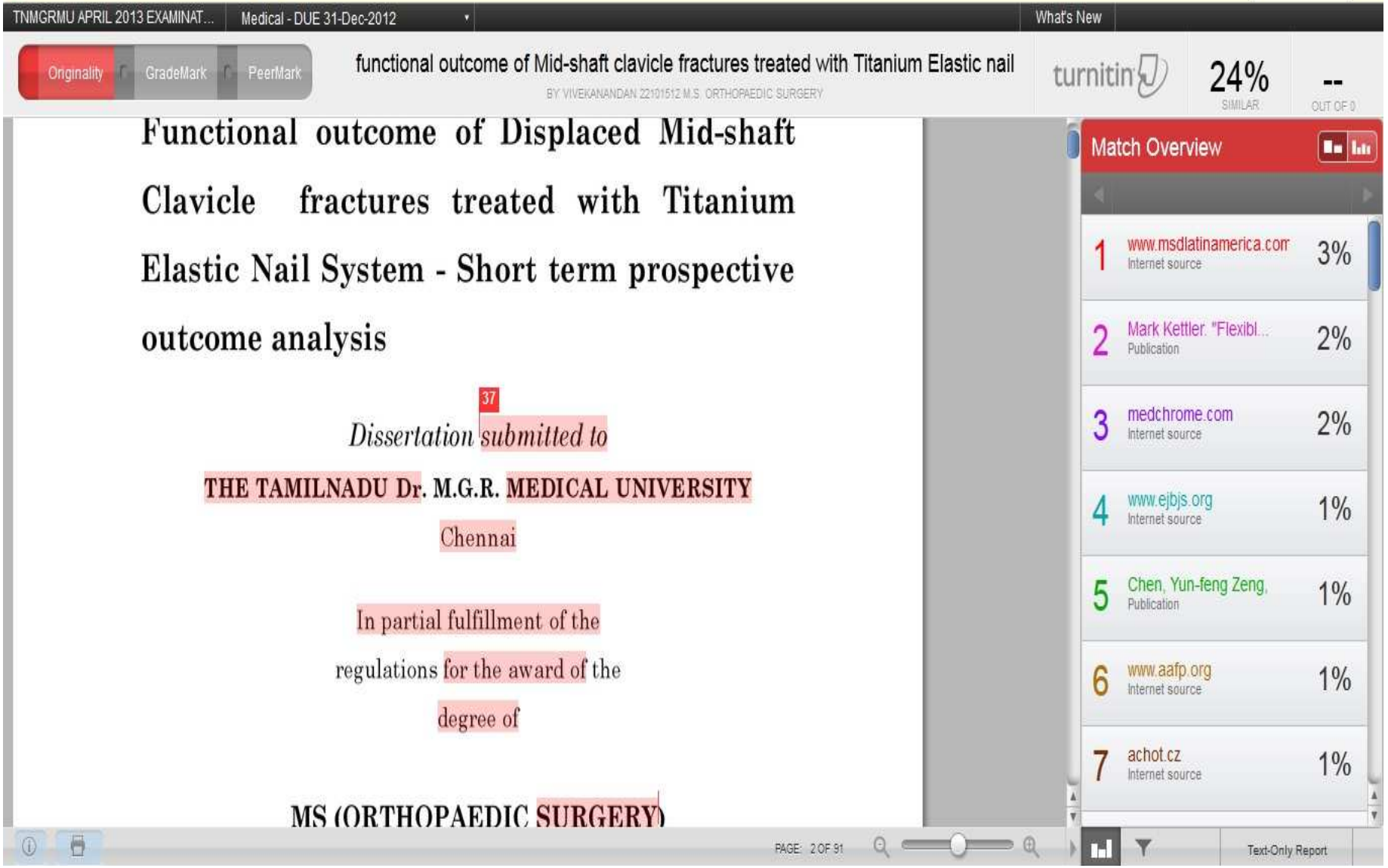
Designation:

Guardian

Relationship
Full address

ABBREVIATIONS

#	Fracture
VAS	Visual Analogue Score
DASH- Score	Disability Arm Shoulder and Hand Score
TEN	Titanium Elastic Nail
ESIN	Elastic Stable Intramedullary Nail
OTA	Ortho Trauma Association
CM Score	Constant Murley Score
Rt	Right Side
Lt	Left Side
AC Joint	Acromio Clavicular Joint
SOH	Shaft of Humerus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Chennai
In partial fulfillment of the
regulations for the award of the
degree of
MS (ORTHOPAEDIC SURGERY)
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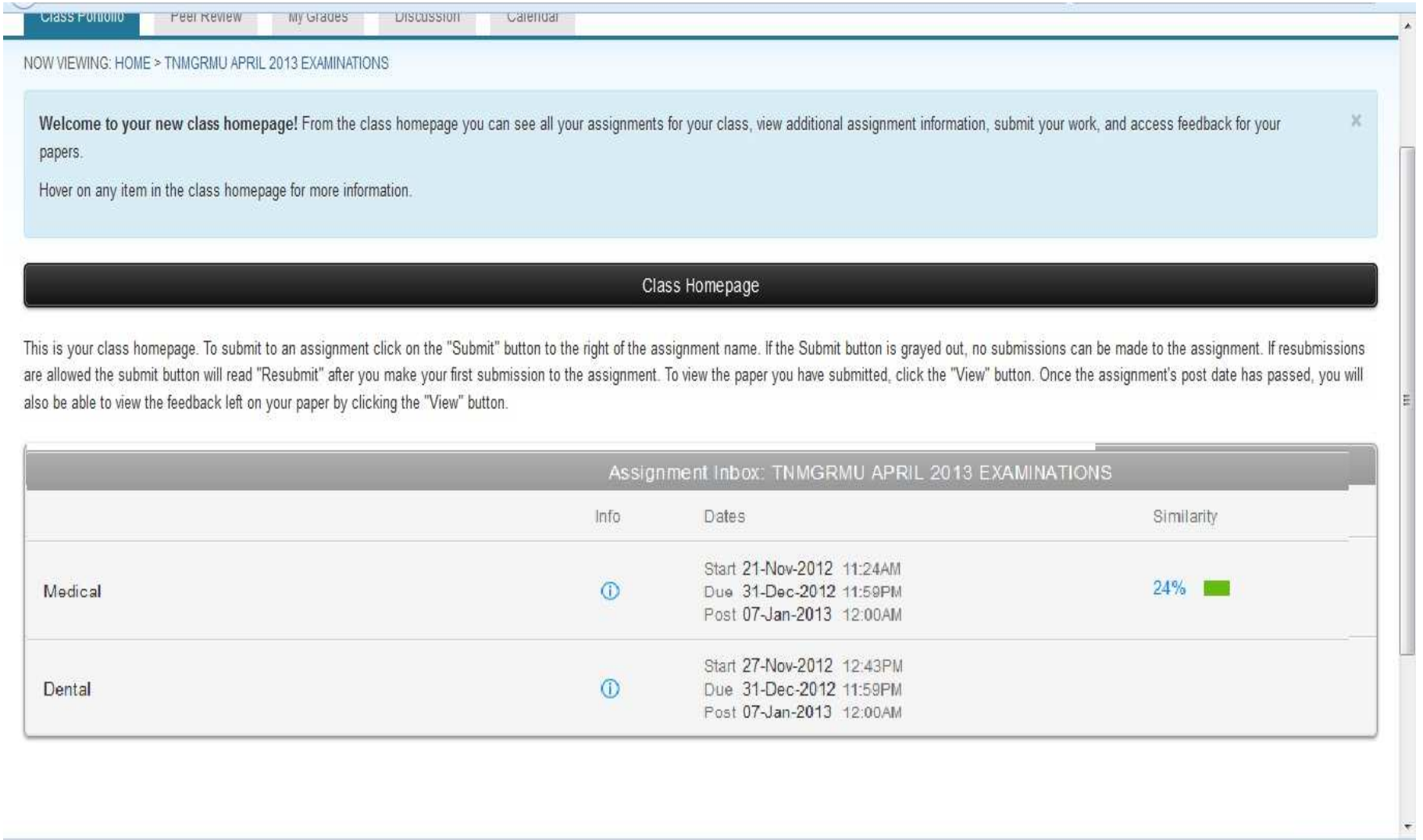
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INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI -3

Telephone No : 044 25305301
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CERTIFICATE OF APPROVAL

To
Dr. R. Vivekanandan
PG in MS Orthopaedics
Madras Medical College, Chennai -3

Dear Dr. R. Vivekanandan

The Institutional Ethics committee of Madras Medical College, reviewed and discussed your application for approval of the proposal entitled "A study on functional outcome of midshaft clavicle fracture treated with flexible intramedullary nail" No.13092012.

The following members of Ethics Committee were present in the meeting held on 13.09.2012 conducted at Madras Medical College, Chennai -3.

1. Dr. S.K. Rajan. M.D.,FRCP.,DSc	-- Chairperson
2. Prof. Pregna B. Dolia MD Vice Principal, Madras Medical College, Chennai -3 Director , Institute of Biochemistry, MMC, Ch-3	--Member Secretary
3. Prof. B. Vasanthi MD Professor of Pharmacology ,MMC, Ch-3	-- Member
4. Prof. M. Reghu MD Director, Inst. Of Internal Medicine, MMC, Ch-3	-- Member
5. Prof. MD. Ali. MD.DM Prof & HOD of MGE, MMC, Ch-3	-- Member
6. Prof. P. Karkuzhali. MD Director i/c, Prof., Inst. of Pathology, MMC, Ch-3	-- Member
7. Prof. Bavani Shankar. MS Prof of General Surgery, MMC, Ch-3	-- Member
8. Thiru. S. Govindsamy. BABL	-- Lawyer
9. Tmt. Arnold Soulina MA MSW	-- Social Scientist

We approve the proposal to be conducted in its presented form.

Sd/ Chairman & Other Members

The Institutional Ethics Committee expects to be informed about the progress of the study, and SAE occurring in the course of the study, any changes in the protocol and patients information / informed consent and asks to be provided a copy of the final report.

Member Secretary, Ethics Committee

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A Prospective Study of Functional outcome of Displaced Mid-shaft Clavicle fractures treated with Titanium Elastic Nail System - Short term prospective outcome analysis Dissertation submitted to THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY Chennai In partial fulfillment of the regulations for the award of the degree of MS (ORTHOPAEDIC SURGERY) BRANCH – II MADRAS MEDICAL COLLEGE CHENNAI MARCH - 2013 CERTIFICATE This is to certify that this dissertation in " Functional outcome of Mid-shaft Clavicle fracture treated with Titanium Elastic Nail System. - Short term prospective outcome analysis" is a bonafide work done by Dr. R.VIVEKANANDAN under my guidance during the period 2010 – 2013. This has...